Journal of the Royal Society of Arts

NO. 4946 FRIDAY, 4TH MARCH, 1955 VOL CIII

FORTHCOMING MEETINGS

WEDNESDAY, 9TH MARCH, at 2.30 p.m. '*The Beauty of Stained Glass*', by Carl Edwards. The Right Honble. Lord Mottistone, F.S.A., F.R.I.B.A., D.L., will preside. (The paper will be illustrated with lantern slides and examples of work.)

THURSDAY, 10TH MARCH, at 7.30 p.m. FILM EVENING. '*Steel and Atomic Energy*', '*Power to Fly*', '*Slice of Life*' and '*Ant Warfare*'. (Full details were announced in the last issue of the *Journal*.)

MONDAY, 14TH MARCH, at 6 p.m. The first of three CANTOR LECTURES on '*The Mechanical Properties of Metals*', entitled '*Tensile Properties*', by Hugh Ford, D.Sc., Ph.D., M.I.Mech.E., Professor of Applied Mechanics, Imperial College of Science and Technology. (The lecture will be illustrated with lantern slides.)

WEDNESDAY, 16TH MARCH, at 2.30 p.m. ALFRED BOSSOM LECTURE. '*English Church Architecture*', by A. B. Knapp-Fisher, F.R.I.B.A., F.S.A., Hon.A.R.C.A. Sir Alfred Bossom, Bart., F.R.I.B.A., M.P., a Treasurer of the Society, will preside. (The lecture will be illustrated with lantern slides.)

THURSDAY, 17TH MARCH, at 6.30 p.m. DISCUSSION on '*The Future of Shop Design and Window Display*'. (See special notice.)

MONDAY, 21ST MARCH, at 6 p.m. The second of three CANTOR LECTURES on '*The Mechanical Properties of Metals*', entitled '*Creep*', by Professor E. N. da C. Andrade, D.Sc., Ph.D., LL.D., F.R.S. (The lecture will be illustrated with lantern slides.)

WEDNESDAY, 23RD MARCH, at 2.30 p.m. '*Radio Astronomy*', by A. C. B. Lovell, O.B.E., Ph.D., F.Inst.P., F.R.A.S., Professor of Radio Astronomy, University of Manchester and Director of Jodrell Bank Experimental Station. Sir Ben Lockspeiser, K.C.B., F.R.S., Secretary, Department of Scientific and Industrial Research, will preside. (The paper will be illustrated with films and lantern slides.)

THURSDAY, 24TH MARCH, at 5.15 p.m. COMMONWEALTH SECTION. '*Post-war Changes in Africa*', by the Right Honble. Lord Hailey, P.C., G.C.S.I., G.C.M.G., G.C.I.E. The Right Honble. Lord Milverton, G.C.M.G., will preside. (Tea will be served from 4.30 p.m.)

MONDAY, 28TH MARCH, at 6 p.m. The last of three CANTOR LECTURES on '*The Mechanical Properties of Metals*', entitled '*Fatigue*', by Major P. L. Teed, A.R.S.M., F.R.Ae.S., F.I.M., Deputy Chief of Research and Development, Messrs. Vickers-Armstrongs, Ltd. (The lecture will be illustrated with lantern slides.)

WEDNESDAY, 30TH MARCH, at 2.30 p.m. '*Recent Developments in Deep Sea Diving*', by Sir Robert H. Davis, D.Sc., Chairman, Messrs. Siebe, Gorman & Co., Ltd. Captain W. O. Shelford, R.N. (ret.), late Superintendent of Diving, H.M. Royal Navy, will preside.

Fellows are entitled to attend any of the above meetings without tickets and may also bring two guests. When they cannot accompany their guests, Fellows may give them special passes, books of which can be obtained on application to the Secretary.

EVENING DISCUSSION MEETING

A third Evening Discussion Meeting will be held, on the same lines as the two previous meetings which took place on 20th January and 17th February, on Thursday, 17th March, at 6.30 p.m. The subject will be '*The Future of Shop Design and Window Display*', and the discussion will be opened by Mr. John Gloag, Hon.A.R.I.B.A., a Vice-President of the Society. Mr. A. R. N. Roberts, also a Vice-President of the Society, will preside. Light refreshments will be available for those attending, from 5.45 p.m., for one shilling.

A short report of the second discussion meeting is given on page 254.

APPOINTMENT OF ASSISTANT SECRETARY

The Council have appointed Mr. David Lea to be Assistant Secretary of the Society on the promotion of Mr. Robert V. C. Cleveland-Stevens to the new post of Deputy Secretary.

Mr. Lea was educated at King Alfred School and at Gonville and Caius College, Cambridge.

THE ALBERT MEDAL

The Council are now considering the award of the Albert Medal of the Royal Society of Arts for 1955. They therefore invite Fellows of the Society to forward to the Secretary the names of such men of high distinction as they think worthy of this honour. The Medal was struck to reward 'distinguished merit in promoting the Arts, Manufactures and Commerce', and has been awarded as follows in previous years:

1864	Sir Rowland Hill	1868	Sir Joseph Whitworth
1865	His Imperial Majesty Napoleon III	1869	Baron Justus von Liebig
1866	Michael Faraday	1870	Vicomte Ferdinand de Lesseps
1867	Sir W. Fothergill Cooke and Sir Charles Wheatstone	1871	Sir Henry Cole
		1872	Sir Henry Bessemer

1873 Michel Eugène Chevreul
1874 Sir C. W. Siemens
1875 Michel Chevalier
1876 Sir George B. Airy
1877 Jean Baptiste Dumas
1878 Sir Wm. G. (afterwards Lord) Armstrong
1879 Sir William Thomson (afterwards Lord Kelvin)
1880 James Prescott Joule
1881 Prof. August Wilhelm Hofmann
1882 Louis Pasteur
1883 Sir Joseph Dalton Hooker
1884 Captain James Buchanan Eads
1885 Sir Henry Doulton
1886 Samuel Cunliffe Lister (afterwards Lord Masham)
1887 HER MAJESTY QUEEN VICTORIA
1888 Professor Hermann Louis Helmholtz
1889 John Percy
1890 Sir William Henry Perkin
1891 Sir Frederick Abel, Bt.
1892 Thomas Alva Edison
1893 Sir John Bennet Lawes, Bt., and Sir Henry Gilbert
1894 Sir Joseph (afterwards Lord) Lister
1895 Sir Isaac Lowthian Bell, Bt.
1896 Professor David Edward Hughes
1897 George James Simons
1898 Professor Robert Wilhelm Bunsen
1899 Sir William Crookes
1900 Henry Wilde
1901 HIS MAJESTY KING EDWARD VII
1902 Professor Alexander Graham Bell
1903 Sir Charles Augustus Hartley
1904 Walter Crane
1905 Lord Rayleigh
1906 Sir Joseph Wilson Swan
1907 The Earl of Cromer
1908 Sir James Dewar
1909 Sir Andrew Noble
1910 Madame Curie
1911 The Hon. Sir Charles Algernon Parsons
1912 The Right Hon. Lord Strathcona and Mount Royal
1913 HIS MAJESTY KING GEORGE V
1914 Senatore (afterwards Marchese) Guglielmo Marconi
1915 Sir Joseph John Thomson
1916 Professor Elias Metchnikoff
1917 Orville Wright
1918 Sir Richard Tetley Glazebrook
1919 Sir Oliver Joseph Lodge
1920 Professor Albert Abraham Michelson
1921 Sir J. Ambrose Fleming
1922 Sir Dugald Clerk
1923 Major-General Sir David Bruce and Colonel Sir Ronald Ross
1924 H.R.H. THE PRINCE OF WALES
1925 Lieut.-Colonel Sir David Prain
1926 Professor Paul Sabatier
1927 Sir Aston Webb
1928 Sir Ernest (afterwards Lord) Rutherford
1929 Sir J. Alfred Ewing
1930 Professor Henry E. Armstrong
1931 H.R.H. THE DUKE OF CONNAUGHT AND STRATHEARN
1932 Frank (now Sir Frank) Brangwyn
1933 Sir William Llewellyn
1934 Sir Frederick Gowland Hopkins
1935 Sir Robert A. Hadfield, Bt.
1936 The Earl of Derby
1937 Lord (now Viscount) Nuffield
1938 HER MAJESTY QUEEN MARY
1939 Sir Thomas H. Holland
1940 John A. Milne
1941 President Franklin D. Roosevelt
1942 Field-Marshal J. C. Smuts
1943 Sir John Russell
1944 Sir Henry Tizard
1945 Winston (now Sir Winston) Churchill
1946 Sir Alexander Fleming and Sir Howard Florey
1947 Sir Robert Robinson
1948 Sir William Reid Dick
1949 Sir Giles Gilbert Scott
1950 Sir Edward Appleton
1951 HIS MAJESTY KING GEORGE VI
1952 Sir Frank Whittle
1953 Dr. E. D. (now Lord) Adrian
1954 Sir Ambrose Heal

JOURNAL INDEXES AND BINDING CASES

The index and title page for Volume 102 of the *Journal* can be obtained free of charge by Fellows who apply for them.

Binding cases for the *Journal* can be obtained direct from the Society's bookbinders, Messrs. P. G. Chapman & Co., Ltd., Kent House Lane, Beckenham, Kent, on payment of four shillings and sixpence, post free. An index and title page will be included.

Copies of the ten volume index, covering the period November, 1942, to November, 1952, are also available and will be sent on application to the Secretary. The price is five shillings.

MEETING OF COUNCIL

A meeting of Council was held on Monday, 14th February, 1955. Present: The Earl of Radnor (in the Chair); Sir Frank Brown; Sir Edward Crowe; Mr. Robin Darwin; Sir John Forsdyke; Mr. P. A. Le Neve Foster; Mr. John Gloag; Sir Ernest Goodale; The Earl of Halsbury; Dr. R. W. Holland; Mr. William Johnstone; Lord Latham; Sir Harry Lindsay; Mr. F. A. Mercer; Mr. O. P. Milne; Lord Nathan; Sir William Ogg; Mr. E. M. Rich; Professor A. E. Richardson; Mr. A. R. N. Roberts; Sir Andrew Rowell; Sir Gordon Russell; Sir Harold Saunders; Sir Selwyn Selwyn-Clarke; Sir John Simonsen; Sir Stephen Tallents; Sir Griffith Williams and Mr. J. G. Wilson; with Mr. K. W. Luckhurst (Secretary) and Mr. R. V. C. Cleveland-Stevens (Deputy Secretary).

PRESENTATION TO SIR GODFREY HUGGINS

The Right Honble. Sir Godfrey Huggins, C.H., K.C.M.G., Prime Minister of the Federation of Rhodesia and Nyasaland, was present at the beginning of the meeting to receive from the Earl of Radnor the Silver Medal which he was awarded for the paper on 'Developments in Southern Rhodesia' which he read to the Commonwealth Section in 1953.

ELECTIONS

The following candidates were duly elected Fellows of the Society:

Aslin, Charles Herbert, C.B.E., P.R.I.B.A., Hertford.
Boag, Kenneth James Thomas, Reigate, Surrey.
Bruce, Frank Edward, M.Sc., S.M., A.M.I.C.E., Esher, Surrey.
Chu, Shun, Hong Kong.
Chipperfield, Guy, Beaconsfield, Bucks.
Davie, Thomas Benjamin, B.A., LL.D., M.D., F.R.C.P., Rondebosch, Cape Province, South Africa.
Finch, Lancelot, B.Sc., B.Arch., A.R.I.B.A., Cooma, New South Wales, Australia.

Goodman, Kenneth Corlyon, London.
Green, Stephen Alban, Glasgow.
Gregory, Alec Arthur Victor Constantine, LL.B., London.
Heyworth, Sir Geoffrey, LL.D., Oxted, Surrey.
Holmes, Clarence William Frederick, Oxhey, Herts.
Hume, Hubert Nutcombe, C.B.E., M.C., London.
James, Mrs. Margaret Calkin, London.
Kelly, Kenneth Linden, Teddington, Middx.
Liebes, Mrs. Dorothy, B.A., LL.D., New York, U.S.A.
Meltzer, Miss Anna Elkan, New York, U.S.A.
Munro, Ion Smeaton, O.B.E., London.
Ogun, Josiah Ayorinde, London.
Porritt, Sir Arthur, K.C.M.G., C.B.E., M.A., F.R.C.S., London.
Rennie, Sir Gilbert McCall, G.B.E., K.C.M.G., M.C., London.
Rosse, The Right Honble. The Earl of, M.B.E., F.S.A., Birr, Ireland.
Snook, Mrs. Nina Marguerite, London.
Tozer, Harold Edward, Nottingham.
Vivian, John Valentine Julian, A.R.I.B.A., Bristol.
Watson, Charles Edward Hubert, B.Sc., M.I.C.E., A.M.I.Mech.E., Walton-on-Thames, Surrey.
Wilson, Lt.-Col. George Robert Stewart, C.B.E., R.E. (Retd.), Guildford, Surrey.

THE ARCHIVIST

Mr. D. G. C. Allen, whose appointment as archivist was due to expire in March, was reappointed on a half-time basis for a further year.

SPECIAL ACTIVITIES COMMITTEE

The Earl of Halsbury and Sir Harold Saunders were appointed as additional members to the Special Activities Committee.

SWEDISH EXHIBITION OF INDUSTRIAL DESIGN

A contribution of one hundred guineas was made to the guarantee fund being raised by the Council of Industrial Design to provide a British exhibit in the Exhibition of Industrial Design to be held at Hälsingborg, Sweden, this summer.

VISIT OF THE SECRETARY TO NORTH AMERICA

The good wishes of the Council were expressed to the Secretary on the eve of his visit to Canada and the United States, from where he is due to return on 20th March.

ALBERT MEDAL

Preliminary consideration was given to the award of the Albert Medal for 1955.

OTHER BUSINESS

A quantity of financial and other business was transacted.

INDUSTRIAL ART BURSARIES COMPETITIONS

1954 COMPETITION

At the request of the Council the Industrial Art Bursaries Board again organized a Competition in 1954, and Bursaries of £150 were offered for the design of Carpets; Domestic Electrical Appliances; Domestic Gas Appliances; Domestic Solid-Fuel-Burning Appliances; Dress Textiles; Electric-Light Fittings; Footwear; Furnishing Textiles; Furniture; Laminated Plastics; 'Perspex', and Wall-paper. In addition to these subjects a new section for the design of Women's Fashion Wear was included in the Competition for the first time, in which two awards of £200 and £150 respectively were offered under the Bianca Mosca Memorial Trust. The Sir Frank Warner Memorial Medal was also offered for the best design in the Carpet, Dress Textiles, and Furnishing Textiles Sections.

The Competition was open* to full-time or part-time students, between the ages of seventeen and thirty, of art, architectural, technical or other colleges or schools approved by the Society, and in the Footwear, Domestic Gas and Domestic Solid-Fuel-Burning Appliances Sections eligibility was extended to include young draughtsmen, clerks or other similar persons engaged in those industries, provided that they were recommended as having sufficient ability to compete in a national competition by a responsible officer of the industry concerned. In all, 292 candidates from 63 schools and industrial establishments, entered the Competition; this compares with 232 candidates in 1953, 233 in 1952 and 156 in 1951, in which years the numbers of schools represented were 60, 64 and 45 respectively.

Candidates were required both to undergo a Set Test, carried out under invigilation over a period beginning on the 1st November, 1954, arranged by their schools, and also to submit Examples of Work, chosen from the work done by them in the ordinary course of their studies since 1st September, 1953.

As in the past the Council's purpose in arranging the Competition was to enable successful candidates to broaden their knowledge and experience by travel abroad and the study of foreign design, or in certain cases to obtain art training or industrial experience in this country. The success of the tours made by Bursary winners depends largely upon their meeting manufacturers and industrial designers in the countries visited and, in past years, many people in this country have kindly given assistance by providing helpful introductions. In this connection the Bursaries Board would be grateful to hear from Fellows who may be able to provide help to these students when abroad.

The Council desires to express its thanks to all those who have assisted and advised on the conduct of the Competitions, particularly the firms, organizations and individuals who generously subscribed towards the cost of the Bursaries, the Juries for their voluntary services, and the Principals of the 63 schools represented for their co-operation.

*Special Conditions of eligibility applying to the Women's Fashion Section were announced in the *Journal* of 1st October, 1954.

Awards

The Council, adopting the recommendations of the Industrial Art Bursaries Board based on the reports of the Juries, have awarded Bursaries amounting in value to £2,500. This compares with a total of £2,400 in 1953. The following Awards and Commendations have been made in connection with the 1954 Competitions:

DOMESTIC ELECTRICAL APPLIANCES

Bursary (£150): *Mr. Peter Douglas Durden* (Birmingham College of Arts and Crafts: age 18)

Commended: Mr. Peter Cambridge (L.C.C. Central School of Arts and Crafts: age 25)

ELECTRIC-LIGHT FITTINGS

Bursary (£150): *Mr. Dennis Bernard Gale* (L.C.C. Central School of Arts and Crafts: age 27)

DOMESTIC GAS APPLIANCES

Bursary (£150): *Mr. John Lincoln Fagg* (Kingston School of Art: age 25)

DOMESTIC SOLID-FUEL-BURNING APPLIANCES

Bursary (£150): *Mr. Thomas Alan Burke** (Birmingham College of Arts and Crafts: age 20)

CARPET

Bursary (£150): *Mr. Richard Callaghan* (Royal Technical College, Salford: age 21)

Commended: Miss Patricia Hazel Gourley (College of Further Education, Kidderminster: age 18); *Mr. Martin Hardingham* (Nottingham College of Arts and Crafts: age 21); *Miss Shirley Howard* (Royal Technical College, Salford: age 19)

DRESS TEXTILES

Bursaries (£150 *each*): *Miss Joan Yvonne Smith** (Birmingham College of Arts and Crafts: age 20); *Miss Eleanor Margaret Bennett** (Brighton College of Arts and Crafts: age 20)

(£75 *each*): *Miss Valerie Marjorie Jones** (Coventry College of Art: age 19); *Mr. Brian Harold Knight** (L.C.C. Hammersmith School of Building and Arts and Crafts: age 20)

Commended: Miss Sheila Hodgkinson (Royal College of Art: age 22); *Mr. James Alfred Morgan* (West Sussex College of Arts and Crafts: age 18); *Mr. Brian Lionel Spiers* (West Sussex College of Arts and Crafts: age 23)

* Also awarded Associate Membership of the Society.

WOMEN'S FASHION

Bianca Mosca Award (£200): *Miss Hilary Diane Huckstepp** (Royal College of Art: age 18)

Bianca Mosca Award (£150): *Miss Maria Julianna Andrea Holtzer** (Kingston School of Art: age 18)

Art Congress Studentship Award (£50): *Miss Gaybrielle Vernon Stephen Wilkins* (Industrial candidate, employed by Messrs. Upson's Ltd.: age 20)

Commended: Miss Sylvia Blanche Fenwick (Poole College for Further Education: age 17); *Miss Wendy Lois Selby* (Brighton College of Arts and Crafts: age 19)

FURNISHING TEXTILES

Bursary (£150): *Miss Jean Myers* (Royal College of Art: age 23)

Commended: Miss Rosemary Anne Phillpotts (Farnham School of Art: age 20); *Miss Nancy Stubbs* (Royal College of Art: age 21)

LAMINATED PLASTICS

Bursaries (£75 *each*): *Mr. Brian James Newman** (Kingston School of Art: age 18); *Mr. Richard David Pemberton** (Kingston School of Art: age 18)

'PERSPEX'

Bursaries (£75 *each*): *Mr. David Newton Stephenson** (L.C.C. Central School of Arts and Crafts: age 18); *Mr. Wafik Ramsie Yakan* (Kingston School of Art: age 24)

FOOTWEAR

Bursary (£150): *Miss Josephine Ann Dobbs* (Industrial candidate, employed in the designing department of Messrs. W. Barratt & Co. Ltd.: age 21)

Commended: Miss Gaybrielle Vernon Stephen Wilkins (Industrial candidate, employed by Messrs. Upson's Ltd.: age 20); *Miss Marjorie Spencer* (Industrial candidate, employed by the Portland Shoe Company: age 23); *Miss Shirley Ann Wood* (Thanet School of Art: age 19)

FURNITURE

Bursary (£150): *Mr. Peter Frederick Ashen* (Royal College of Art: age 23)

Commended: Mr. George William Mitchell (Royal College of Art: age 28); *Mr. Gareth John Evans* (Birmingham College of Art: age 20); *Mr. Falcon David Hildred* (Birmingham College of Art: age 19); *Mr. James Andrew Wilson* (Edinburgh College of Art: age 24)

WALL-PAPER

Bursary (£150): *Miss Sarah Josephine Wright* (Royal College of Art: age 24)

Commended: Miss Mary Fieldhouse (Royal College of Art: age 24); *Miss Kathleen May* (Middlesbrough College of Art: age 18)

The Sir Frank Warner Memorial Medal was not awarded.

* Also awarded Associate Membership of the Society.

Publication of Report

Full details of the 1954 Competition will be contained in the annual Report on the Competition which will be published together with the Particulars of the next Competition in May. This Report will contain particulars of the tests set in each section, the names of the winning and commended candidates, the reports and composition of the Juries, and a summary of the uses made of Bursaries in 1954 by previous Bursary winners. Illustrations of most of the winning designs, a number of which are reproduced in the following pages, will also be included.

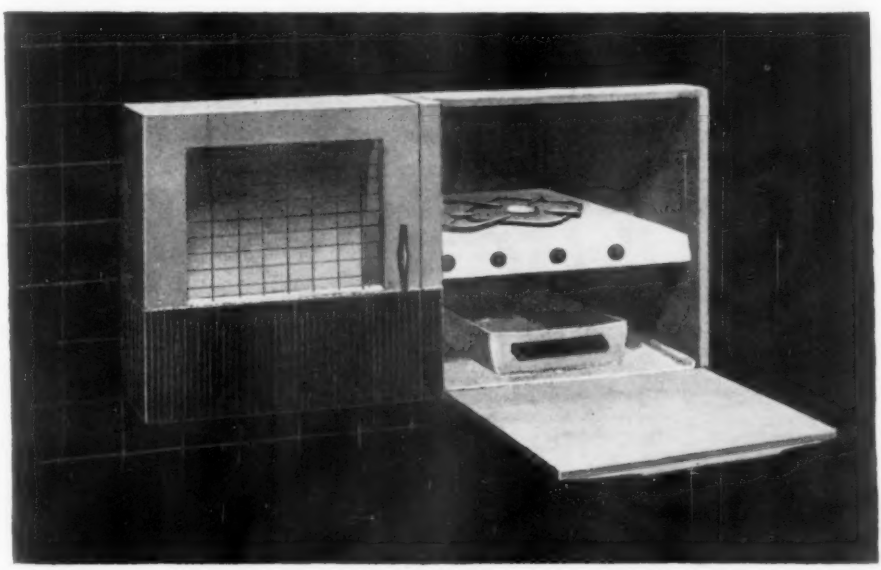
Exhibition

An exhibition of the winning and commended designs in the 1954 Competition, which will be opened by the Right Honble. Sir David Eccles, K.C.V.O., M.P., will be held at the Royal Society of Arts from Monday, 16th May to Saturday, 28th May, 1955, and will be open to the public from 10 a.m. to 5.30 p.m. on Mondays to Fridays, and from 10 a.m. to 12.30 p.m. on Saturdays.

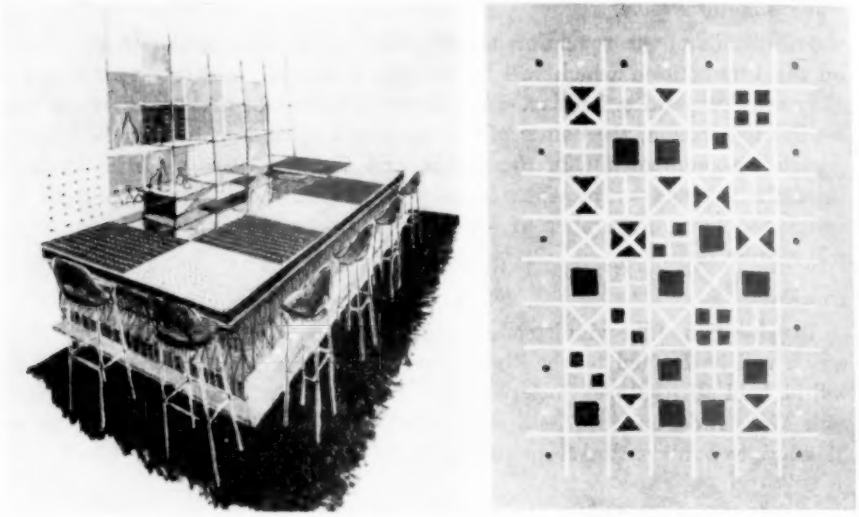
ARRANGEMENTS FOR 1955 COMPETITION

The Council has, as already announced, decided to hold a further Competition in 1955, which will be organized on the same lines as that in 1954. Particulars of this Competition will, as stated above, be published, together with the Report on the 1954 Competition, in May, and the list of sections to be included will then be announced in the *Journal*.

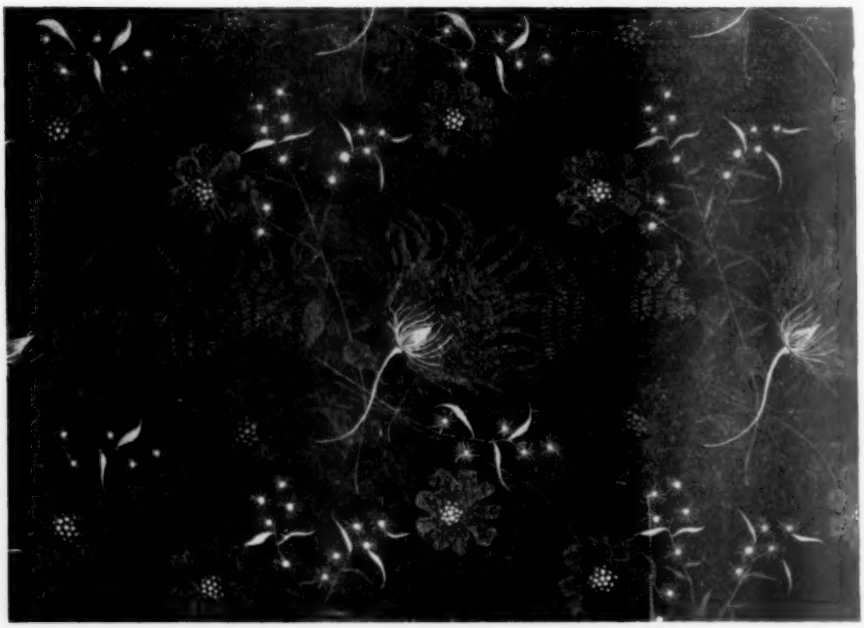
SOME OF THE DESIGNS



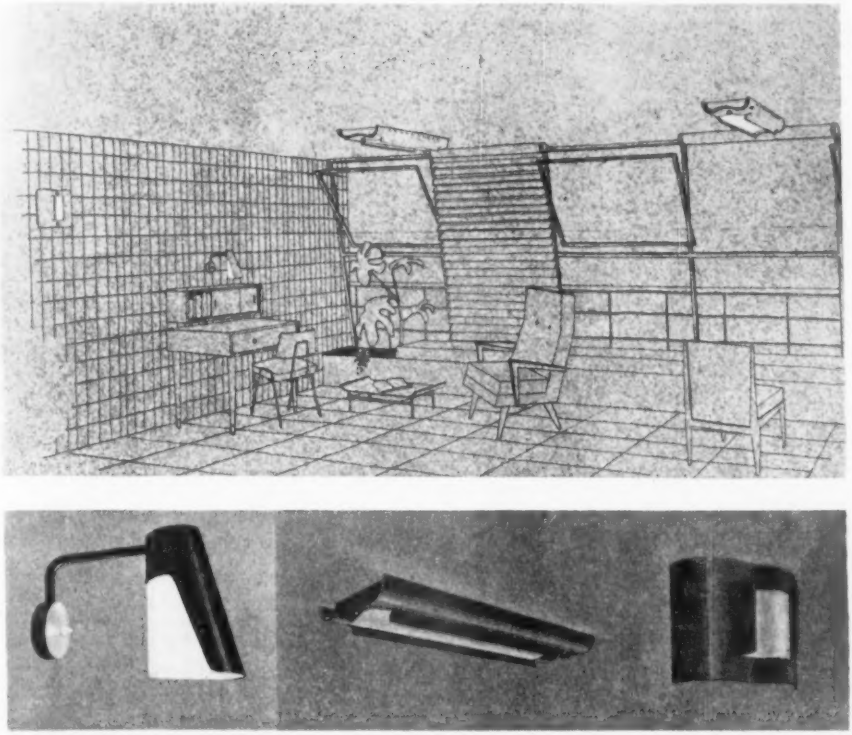
Gas cooking and heating unit, by Mr. J. L. Fagg



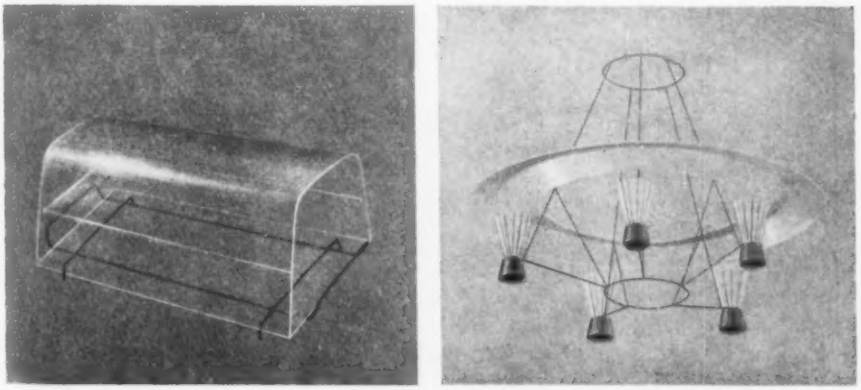
Left : Interior of small cocktail bar using laminated plastics panels, by Mr. R. D. Pemberton. Right : Design for a laminated plastics table-top, by Mr. B. J. Newman



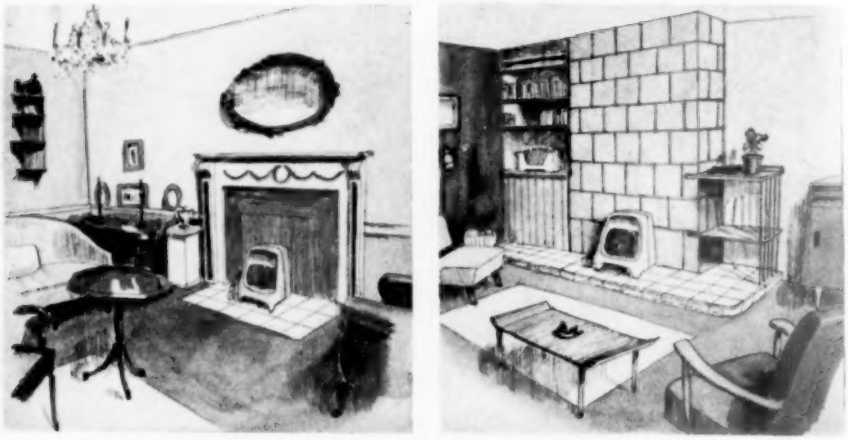
Jacquard woven furnishing fabric for curtains and cover material for use in a living room, by Miss J. Myers



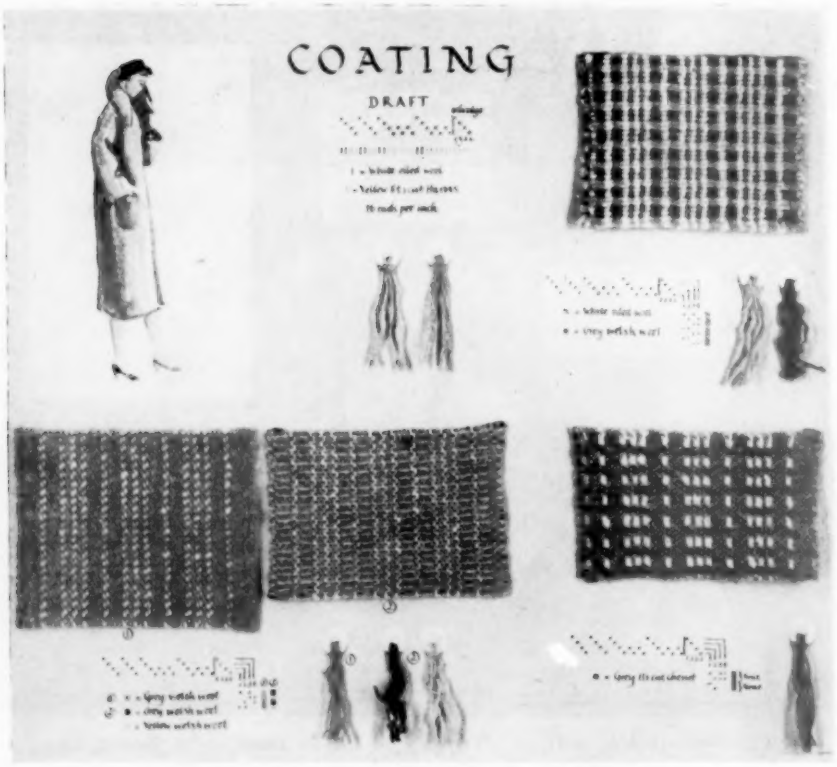
Designs for three electric-light fittings for a luxury suite of a modern liner, and a sketch showing their use, by Mr. D. B. Gale



Left : Food display unit, in 'Perspex', for use in small coffee houses, etc; right : Lighting fitting, in 'Perspex', for an open staircase in either contemporary, or traditionally furnished, surroundings : both by Mr. D. N. Stephenson



Solid-fuel-burning free-standing open fire, either (left) in a traditional or (right) in a contemporary setting, by Mr. T. A. Burke

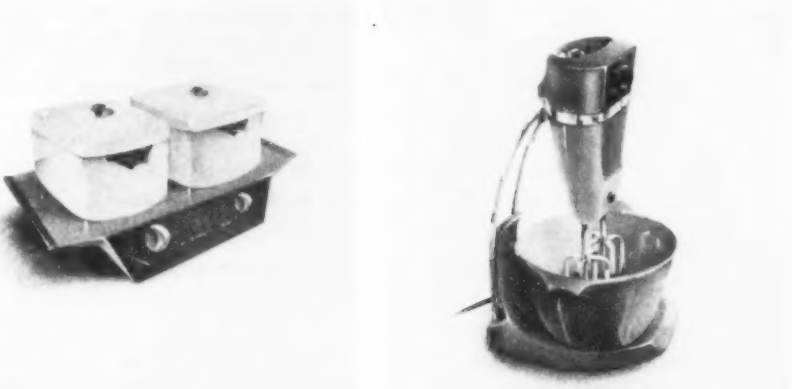


Woven fabric coating designs, by Miss E. Bennett

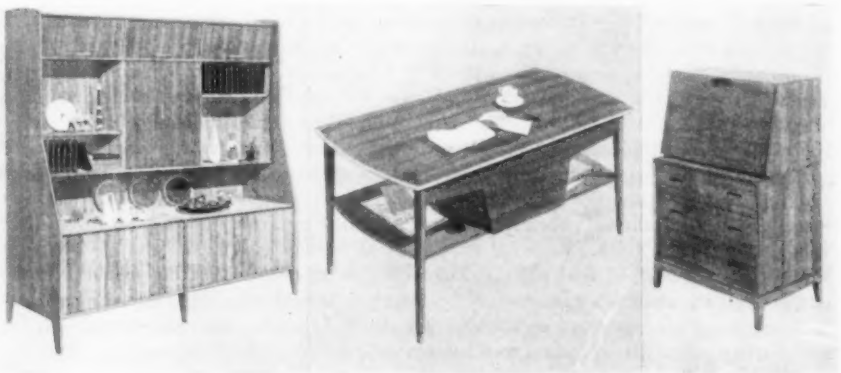
Left : Design for a screen-printed silk afternoon dress fabric, by Miss J. Y. Smith
Right : Design for a screen-printed Shantung dress fabric, by Miss V. M. Jones

Left : Five-colour machine-printed wall-paper for a young girl's bedroom; right : Plant study drawing; both by Miss S. J. Wright

Left : Going-away dress (by air) by Miss M. J. A. Holtzer
Right : Going-away ensemble (by train) by Miss G. V. S. Wilkins



Left : Electric steamer for domestic use ; right : Electric food mixer combining whisking, mincing and liquidising ; both by Mr. P. D. Durden



Left to right : Three items of furniture (in mahogany and cherry), each fulfilling a number of storage functions for a family in a modern Council house, by Mr. P. F. Ashen

Left to right : Afternoon shoe, casual shoe, and evening shoe, by Miss J. Dobbs

RESEARCH IN THE COAL INDUSTRY

The Cadman Memorial Lecture by

W. IDRIS JONES, C.B.E., B.Sc., Ph.D.,

Director-General of Research, National Coal Board, delivered to the Society on Wednesday, 19th January, 1955, with the Honble. L. W. Joynson-Hicks, M.A., M.P., Parliamentary Secretary, Ministry of Fuel and Power, in the Chair

THE CHAIRMAN: I should like at the outset to express my appreciation to the Council of the Royal Society of Arts for having given me the privilege of presiding at the Cadman Memorial Lecture this afternoon. I do not think they require me to say anything to you about the Cadman Memorial Lecture, but it is a very great honour for those of us who are invited to take the chair, as well as those of us who are invited to give the lecture. I shall never be able to aspire to the latter, but I am very pleased to have aspired to the former.

When I received the invitation it occurred to me to wonder what it was that the Chairman was expected to do, and it seems to me there are two objects for which I am here: the first, to present to you Dr. Idris Jones, the lecturer; and the second, to exercise restraint and strong control over the meeting. Having been brought up in the political school I have become accustomed to a good many different types of meetings, and in the earlier days when one used to speak at street corners from motor lorries it was not an uncommon thing for the audience to turn the lorry over and try to burn it. I am hoping that that will not happen to your Chairman this afternoon, but I do like to take all precautions, and I would remind you that Dr. Idris Jones was a Cambridge rugger blue for three years; he was captain of the Welsh rugger fifteen in 1925 and, in 1926, of the Anglo-Welsh fifteen. I will only just add that he has assured me that this afternoon he will be playing on my side in the scrum.

Apart from his career as an athlete, Dr. Idris Jones has also an exceedingly long and distinguished career in fuel technology, and he has worked with such distinguished and great companies as I.C.I. and Powell Duffryn and, after nationalization, with the National Coal Board. In addition to that, he is now in his second year as President of the Institute of Fuel, and so there can really be no one who is in a better position to speak to us on the subject of this afternoon's lecture. Coal mining on the productive side is a business of great hazards and a business of ever increasing difficulties because in an extractive industry difficulties are bound to increase with time. Even since the beginning of the war something of the order of three thousand million tons of coal have been withdrawn from under the surface of Great Britain. You gentlemen will be able to appreciate what three thousand million tons look like. I certainly cannot do it, the figures are much too big for me to be able to comprehend, but I think we would all agree that it would leave an enormously large hole in the ground when it had been taken out, and that does mean that the industry has to work deeper seams than it did before if it is going on extracting the coal and, as naturally one takes the best and most economic first, it has to go on to thinner seams and dirtier seams. At the same time, while the conditions are becoming more difficult, society is rightly demanding better working conditions the whole time for those who are working in the coal mines; and, therefore, on the productive side there is a tremendous scope for research into improved methods of production, on the consumers side into improved methods of preparation, on the transport side into improved

methods of conveyance. Again on the consumption side, as Dr. Idris Jones himself testified last year in his presidential address to the Institute of Fuel, there is immense scope for research work in the purification of the commodity, the withdrawal of the sulphur element. Even later we have had the even greater emphasis thrown upon this by the universal demand for the withdrawal and elimination of smoke in the consumption of solid fuel. All these matters come into the field of research and no one is better qualified to work on them or to talk on them than Dr. Idris Jones.

The following lecture, which was illustrated with lantern slides, was then delivered:

THE LECTURE

I am deeply conscious of the honour the Royal Society of Arts has bestowed upon me by inviting me to deliver the Cadman Memorial lecture this year. This lecture commemorates the first Lord Cadman, a son of Staffordshire, a great man of many parts—a veritable Fuel Leonardo. He gained his early apprenticeship in the coal industry. He had an intimate knowledge of the coal industry and did much for it on the managerial, inspectorate, academic and research sides, and as President of the Institution of Mining Engineers and of the Institute of Fuel. He then became an outstanding leader of the oil industry. He was a rare combination of practical business man, scientist of distinction and public figure with an international reputation. He held many posts and received many honours. His work as Chairman of the Inter-Allied Petroleum Council of 1914–18 contributed largely to the outcome of the war.

Lord Cadman maintained a life-long direct interest in research. In the early twenties of this century he initiated a fund for the purpose of transferring the organization and staff of the Doncaster Coal Owners' research laboratory to the Mining Department of Birmingham University. There Dr. J. S. Haldane continued his direction of the classic researches aimed at understanding the causes of spontaneous underground fires and devising means of prevention and also his investigations on the origin of black damp, on the development of rescue apparatus and on other problems. Sir John Cadman, as he then was, was also Chairman of the Committee of the Institution of Mining Engineers concerned with work on the control of atmospheric conditions in hot and deep mines, a problem which is becoming of increasing importance nowadays.

I cannot help feeling that if Lord Cadman were alive to-day he would not be uninterested in the subject of my lecture; he was a man of broad vision and dynamic enterprise who probed to the basis of things and looked to the future.

RESEARCH FOR THE COAL-MINING AND ASSOCIATED INDUSTRIES

From the seventeenth century onwards, with increasing momentum, an enormous amount of labour and patient endeavour was expended on research work on technical, medical and human problems by many individuals, committees and associations for the benefit of the coal industry and its employees. And yet, despite the worthy research efforts for the industry by these diverse agencies, within the industry, considering its size and immense national importance, scientists played a relatively minor part before 1947.

In addition to coal, the coal industry produces gas, coke, tar, benzole, refractories and other products. It is provided with diverse surface plants, transport services, underground machinery and equipment of various kinds. The variety of the coals produced is wide and the coalfields have a very complicated structure, making the problems of the industry even more diverse. The industry is also faced with difficult medical and human problems. Therefore the opportunities for science and research within and for the industry are very considerable.

SCIENCE IN THE NATIONALIZED COAL INDUSTRY

The most important single change effected by nationalization from the scientific standpoint was that science was given direct representation at board level, by the appointment of Sir Charles Ellis, F.R.S. as scientific member. It is not unreasonable to say that thanks to his initiative and inspiration, and the great stimulus given by the National Coal Board and divisional boards and the efforts and team spirit of our staffs, encouraging progress has been made on the scientific side since 1947. This progress has been limited only by the difficulty of recruiting first class scientists and obtaining suitable accommodation.

TABLE I. ORGANIZATION OF THE BOARD'S SCIENTIFIC SERVICES

SCIENTIFIC MEMBER
(Sir Charles Ellis)

SCIENTIFIC CONTROL, etc. (Director: Mr. D. Hicks)		RESEARCH (Director-General: W. Idris Jones)
	Administration Intelligence Liaison	
—*Scientific Control:* Mr. F. C. Marrison		—*C.R.E.*1*:* Dr. J. Bronowski (*Stoke Orchard*)
—*Coal Survey:* Mr. A. Wandless		—*C.R.E.* 2*:* Dr. L. Tyte (*Isleworth*)
—*Field Investigation:* Mr. Rivett		—*Extramural:* Mr. A. Whitaker
—*Pneumoconiosis Field Section:* Dr. J. W. J. Fay		—*Medical and Human Problems:* Dr. J. Rogan
—(*Division and Area Organizations*)		—*External Liaisons*
Expenditure: 1.4*d*/ton of coal *Strength:* About 2500		*Expenditure:* 1*d*/ton coal *Strength:* About 700

The organization and cost of the Board's scientific services are set out in Table I. In addition, a considerable sum is spent on development work by the Production Department of the Board and a Central Engineering Development Establishment is in course of erection.

TABLE II. RESEARCH OBJECTIVES AND AGENCIES

1.	Coal Winning	C.R.E. 2 and Extramural
2.	Coal Transport	C.R.E. 2 and Extramural
3.	Environmental and Safety	C.R.E. 2 and Extramural
4.	Coal Preparation	C.R.E. 1 and Extramural
5.	Production of Hard Coke	C.R.E. 1 and Extramural
6.	Briquette Production	C.R.E. 1
7.	Production of Smokeless Fuels ...	C.R.E. 1 and Extramural
8.	Utilization of By-Products	C.R.E. 1 and Extramural
9.	Fundamental Properties of Coal ...	C.R.E. 1, C.R.E. 2 and Extramural
10.	Study of Medical Problems	Med. and Human Problems
11.	Study of Human Problems	Med. and Human Problems
12.	Vital Statistics, etc.	Med. and Human Problems

The main research objectives and agencies are set out in Table II. About 140 separate investigations are currently in progress, including about 40 projects at 12 universities, but excluding the work in the Research Associations to which the Board subscribe liberally. Time will obviously permit only a brief account of a few of these investigations.

SOME PROBLEMS OF COAL CUTTING

In view of the high degree of mechanization of our coal mines at the present time a study of the various processes involved in coal winning is highly important. We are pursuing this study from both ends of the research spectrum, i.e. basic research and applied research.

Various methods have been developed in the past for cutting coal from the seam, leading up to the modern jib, Meco Moore, Samson stripper and coal plough types of cutters; each of which has its own specific mechanism.

The coal plough comprises in essence a blade which is drawn along the coal face, planing the coal from the seam and loading it on the conveyor running parallel to the face. The coal ploughs developed by the Germans showed great promise when operating on the relatively soft coals of the Ruhr. Their successful application to the harder British coals however involves either making a more efficient blade or devising means of generating the higher force demanded by a conventional blade.

Applied research

Our engineer scientists are approaching these problems by investigating the operational variables underground.

In the case of the coal plough the underground work has been directed to the generation of greater force to propel the blade. The forces already employed had been increased up to the limit set by the size and strength of the haulage equipment. The depth of cut taken by the plough had also been reduced to the minimum consistent with the production of a reasonable size of lump coal, output being maintained by a proportionate increase in speed along the face. The problem remaining to be solved was to generate greater force without increasing the tension in the haulage rope, that is, by the employment of inertia by accelerating a mass with the force available and making the coal bring it to rest in a shorter distance, thus generating greater force than the accelerating force, i.e. the plough was made percussive. Laboratory tests had already shown that the force propelling a blade fluctuates widely from the high values necessary to create fracture to the low values involved in clearing away the broken coal. It was accordingly proposed by our Marsh and Withers to use the haulage force to initiate percussion only when the force tended to exceed a predetermined limit. This rendering of a machine sensitive to its environment by means of a simple servo-mechanism has given very promising results. An experimental plough, powered by compressed air, has cut at a high rate a very tough seam in South Wales, aptly named the Garw seam, and with only a quarter of the normal average tension on the haulage rope (Figure 1).

In fact it was sufficiently promising to encourage the direct development of a prototype production machine which, if all goes well, will be producing coal this year.

Basic research at Isleworth

The efficient and rational design of coal cutting machinery depends on a knowledge of how coal breaks when it is stressed and in view of the complexity of these stresses simple systems are now being studied at Isleworth.

(1) *Physical properties of coal*

Crushing tests on cubes of coal gave a very wide scatter of strength about the mean indicating that it must be treated statistically and that classical strength theories cannot be applied to coal.

Tensile strength results also showed a distribution of values and indicated that the mean tensile strength of coal may be only one tenth of its compressive strength. Stress-strain diagrams are being obtained from which elastic constants can also be derived; the latter are being measured independently, from the resonance frequencies of strips of coal vibrating at ultrasonic frequencies. The order of Young's modulus for coal has been found to be about 10^5 p.s.i.

Before coal actually breaks under stress, it behaves more or less as a simple elastic material, i.e. its compression or extension is directly related to load. When breakage occurs the elastic energy which is stored during the application of load is released suddenly and the coal appears almost to explode and chips fly from the cutting edge with great speed.

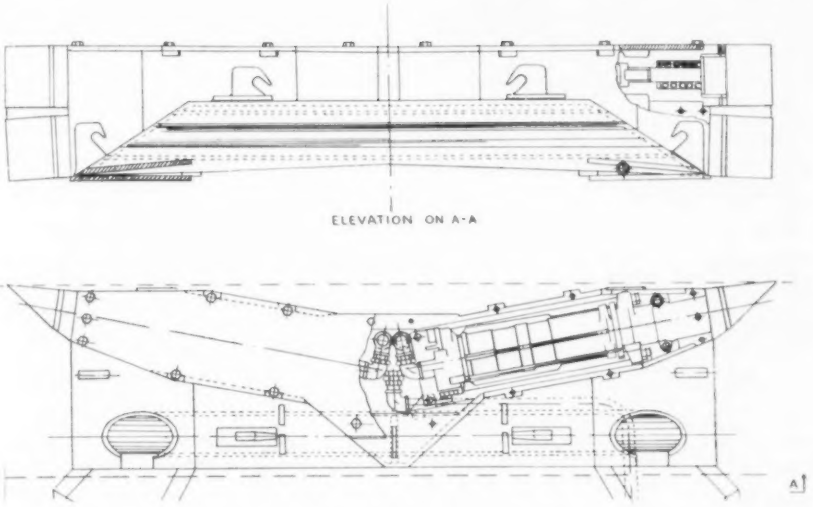


FIGURE 1. *Diagram of an experimental coal plough*

Anthracites are exceptionally strong and brittle and break conchoidally into sharp-edged prismatic fragments. As the rank decreases the strength falls to a minimum and then increases until the low rank coals are tough and strong, with compressive strengths near those of anthracites although they do not break in the same way as anthracite and their fragments are not very sharp. A low rank coal such as Barnsley Hards shows the 'creep' phenomenon when stressed short of the breaking point over long periods. Anthracite does not show 'creep', and this may explain the 'coal bursts' which are observed in anthracite mines.

Compression tests have also shown that the direction of application of load relative to the bedding planes is important. Thus Barnsley coal is weakest when the compressive load is parallel to the bedding plane while anthracite is weakest when the load is perpendicular to the bedding plane. The tensile strength of Barnsley Hards is least when tensile forces are applied at right angles to the bedding planes, but anthracite is weakest when the tensile forces act parallel to the bedding plane.

(2) *Application to coal cutting*

Interesting applications of basic research have been made at Isleworth in laboratory studies of coal cutting, e.g. the energy required to break the same quantity of coal by dynamic impulses from a similarly shaped cutting tool. For small impulses there was a large waste of energy and the blow merely produced an elastic strain with no fracture of the coal. As the blows became harder breakdown occurred with increasing efficiency up to an optimum value. Above this value energy was again wasted and the fragments were broken from the

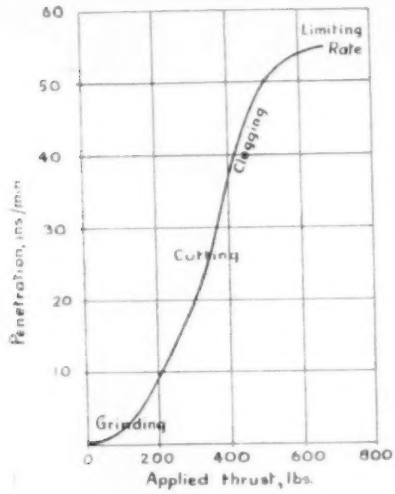


FIGURE 2. *Characteristic curve for scroll type rotary drill in Darley Dale sandstone*

lump with high speed, without affecting the ultimate size distribution of the broken coal. These results are being applied to the design of production methods involving the ploughing of the coal seam.

The forces required to propel a blade in coal have also been measured at Isleworth and related to the properties of the coal and in particular to the relative orientation and intensity of the inherent weaknesses. Tensile stress has been shown to be considerably more damaging to coal than shear so that the fracture induced by the blade will tend to be orthogonal to the direction of principal tensile stress in preference to a plane of maximum shear stress. It is therefore desirable in practice to arrange for the principal tension to occur across the major planes of weakness in the coal. The sharper the blade the better, because higher tensile stresses are developed by a sharp blade. A sharp blade would not be so important if fracture had been induced by shear nor would it be if the blade penetrated far into the coal before fracture occurred; in fact, the pre-fracture penetration is very slight indeed.

These studies have given us a closer insight into the problems of winning coal from the seam and a better understanding of machine operation, and have enabled us to postulate tentative general principles on which to base the design of a new machine and to predict its performance.

ROCK DRILLING

Another example of the approach from the applied research side is our work on rotary drilling of rock. For a long time holes were driven into rock by percussion, which is not very rapid and consumes much power. The more efficient rotary method had only been applied to coal. We sought to apply it to hard rock.

Laboratory drill rigs were installed first at Stoke Orchard and then at Isleworth, and work indicated that a solid rod externally-scrolled drill, propelled by human force, as is done in the case of coal, could not drill rock efficiently, the cutting edges advancing only about one thousandth of an inch in each revolution and thus suffering severe abrasion. The application of greater thrusts mechanically produced a remarkable improvement, the cutting edges bit into the rock and advanced as much as one quarter of an inch per revolution for a threefold increase in thrust; the abrasion was correspondingly reduced (Figure 2).

Two limits appeared with further increases in thrust. With very hard rocks, and the consequent large forces required for drilling, the hard tungsten carbide cutting edges began to exhibit a new form of deterioration, namely chipping and

rapid failure similar to that resulting by the action of shock-loading on brittle materials, quite distinct from the abrasion suffered under comparatively small forces. The externally-scrolled drill rods carrying the cutting edges also began to fail from sheer lack of strength.

The second limitation, characteristic of most of the rocks encountered in mining, appeared when the external scrolls were unable to remove debris from the hole as fast as it was produced. This limitation has now assumed importance as the ultimate limit to the progress of any mining machine. No machine, however efficient, can cut material from the solid faster than its associated equipment can remove the debris. In drilling we were able to overcome or at least to retard the onset of this limitation by using a smooth tubular drill stem and flushing out the drillings with water. This expedient, suggested by Winder, has retarded the onset of clogging; indeed, in drilling granular materials, we have temporarily lost sight of it; even at 16 ft. per minute, the maximum drilling speed so far achieved in medium hard sandstone, clogging is not apparent. Sticky shales unfortunately only permit a fraction of this unprecedented speed. The adoption of a tubular construction for the drill rod also yields a considerable gain in strength for a given weight and largely solves the strength problem without causing further obstruction in the hole (Figure 3).

The advent of the hollow rotary drill has permitted fundamental changes to be contemplated, in the design of drilling machines, for instance, and we are currently engaged in the design of a machine which we hope will facilitate the drilling of holes for all purposes in collieries. It differs from existing machines primarily in the method employed to thrust the drill forward as it advances; it remains stationary during the process. Most other drilling machines are obliged to move forward with the drill; this demands additional space and involves difficulty in providing support for the machine to resist the high thrusts essential for efficient rotary drilling. With the new machine it should be possible to use

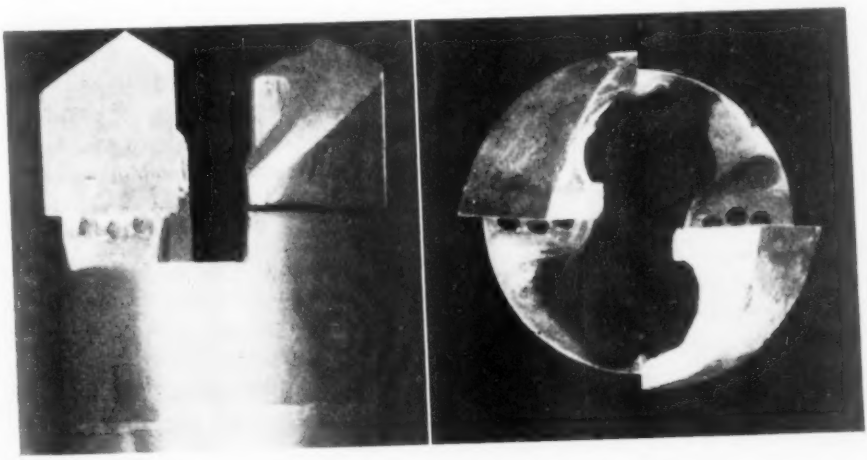


FIGURE 3. *Head of tubular drill rod*

very simple supports and even in certain circumstances to attach the machine to the actual rock face being drilled. Work proceeds apace on these lines and also on investigations of the characteristics and possibilities of rotary percussive drilling.

HYDRAULIC TRANSPORT

In view of the high costs of underground transport new forms of coal movement from the coal face are being investigated; among these is hydraulic transport. Solids suspended in liquids have been pumped in a number of industries and the principle is being used notably in heavy medium coal preparation plants. Until recently insufficient knowledge of the hydrodynamics of such suspensions was available to enable large permanent installations to be designed for continuous and reliable service and at maximum economy. The first considerable research on these problems was carried out in France by the Laboratoire Dauphinois d'Hydraulique. Following some preliminary work at Stoke Orchard it was decided to invite the British Hydromechanics R.A. to take over this project as a research sponsored by the N.C.B. Considerable progress has since been made in the accumulation of the scanty existing data and supplementing these by controlled experiments on various pipelines in the laboratory and enough is now known to prove that the method should be reliable and economic, and to justify the development of the various specialized mechanisms which will be needed. Work will therefore be concentrated on systems for raising coal from the working levels of the pits to the surface, since the hydrodynamics of these vertical systems are relatively simple. The next extension will be the application of hydraulic transport to conveying coal from the working districts to the shaft bottom. The hydrodynamics of such systems are more complex and unless precautions are taken and appropriate control devices used, the systems may be inherently unstable and fail by separation of coal in the pipe with consequent blockage. This instability is due to the fact that for any particular suspension in a pipe of given size there is a critical velocity above and below which the pressure gradient will rise. If the system is allowed to operate near to or below this minimum velocity and the pump used is not of the instant flow type a small disturbance of the system, for example, by a variation in the rate of coal feed, may produce instability. Sufficient information is now available to enable the pressure-flow characteristics of all systems, and of separate components in them, to be predicted and to allow control gear to be devised to ensure that stability and economy of power are simultaneously maintained.

Hydraulic transport of coal could be used not only to transmit the coal from the working districts to the shaft bottom and up the shaft to the surface treating plants but direct to the surface *via* vertical boreholes at the working districts. It would be most useful to convey the coal from a number of pits to a central washery, and from washeries to power stations and other points of use, thus avoiding multiple handling of the coal into and out of rail wagons, etc., and overcoming obstacles such as railway lines, buildings and rivers.

A most important advantage which would accrue from the use of hydraulic

transport underground would be the great reduction of fire and explosion risks and of the dust raised by conventional methods of coal transport, and financial savings in respect of precautionary measures necessary to counter these hazards.

Initial calculations have shown that hydraulic transport should be much more economic than the normal transport systems now in use underground.

COAL PROCESSING

Coal is not only our primary source of heat and power but also an essential factor in the production of metallurgical coke, chemicals, plastics, textiles, etc. The demand for these products is increasing and it is important to enquire as to the part coal will play as a raw material in the future, more particularly in view of the role of petroleum oil as a source of energy, of gas and of chemicals. More attention is being directed to the problem of smokeless fuel production to improve the state of the atmosphere notably in our large and industrial cities and towns, as is evidenced once more by the recent Air Pollution Committee report. Another factor of importance is that high volatile non-caking or weakly caking coals constitute the major proportion of our coal reserves.

Various methods of coal treatment such as thermal decomposition, oxidation, hydrogenation, gasification and hydrocarbon synthesis have been tried with varying success in the past. We are concentrating at Stoke Orchard on the thermal treatment of coal, hydrogenation and synthesis being economically unattractive on current United Kingdom prices and gasification being regarded as the primary responsibility of the Gas Council.

Hitherto both H.T.C. and L.T.C. of coal have been used extensively, the first mainly for the production of hard metallurgical cokes and the second for reactive smokeless domestic fuels. Features of these processes are set out in Table III.

TABLE III

	H.T.C.	*L.T.C.*
Coke yield, cwts./ton coal	14·5	15·0
Coke reactivity (CAB, cu. ft./min.)	Up to 0·08	About 0·04
Tar yield, gals./ton coal	Aromatic	Paraffinic-Naphthenic-Aromatic
Tar production in 1953	2·75 m. tons	8 m. gallons
Crude spirit yield, gals./ton coal . .	About 2·0	2·5–3·5
Crude spirit production in 1953 . .	106 m. gallons	1½ m. gallons
Gas, cub. ft./ton coal	Up to 12,500	Up to 4,500

Both processes require coking coals and these are becoming scarce and expensive to mine. The demand for hard coke and solid smokeless fuel is also increasing. To what extent therefore can we make good and better quality hard cokes by scientific blending of the weakly caking coals with the best coking

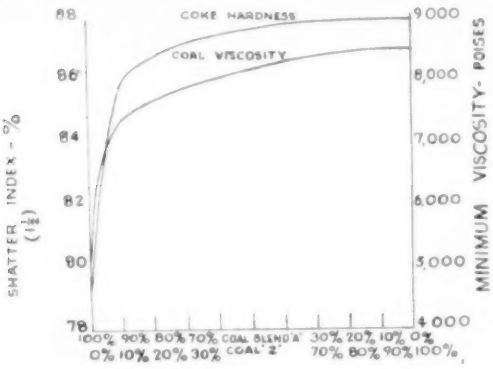


FIGURE 4. *The effect of blending on coal viscosity and coke hardness*

coals and by improved processing of the second grade coking coals? Can we process low rank coals in such a way that they will serve all the purposes we now associated with high rank coals and give high quality hard cokes and also reactive cokes? How too can we reduce the capital costs of carbonizing plant and reduce the heat losses characteristic of these plants? These are important questions that we are endeavouring to answer at Stoke Orchard.

Hard coke production

The work at Stoke Orchard aims at using a wider range of coals for classical coke production and at evolving new types of hard cokes. Attention is being concentrated on the fundamental aspects.

It is well known that some coals pass through a fluid or plastic state when heated and the work at Stoke Orchard has shown that there is a direct relationship between this fluidity and the hardness of the resulting coke (Figure 4). It also appears that a certain optimum viscosity must be achieved before a satisfactory coke will result (Table IV).

TABLE IV. VARIATION OF COKE STRENGTH WITH VISCOSITY

Composition		*Volatile Matter per cent d.a.f.*	*Minimum Viscosity (poises)*	*1½ in. Shatter Index*
per cent A	*per cent B*			
100	—	—	5,500	79
75	25	—	39,300	84
50	50	34·9	71,000	84
50	50	34·1	444,000	84
50	50	33·4	835,000	77
50	50	34·1	1,510,000	71

If a sample of coal is heated very rapidly to about 400°C. and thereafter maintained at a constant temperature, the viscosity increases at a steady rate, due to a steady increase in the amount of semi-coke (Figure 5). Using this increase in viscosity as a measure of the increase in the amount of semi-coke, the reaction velocities and the activation energy as derived from the Arrhenius equation have been calculated for a number of coals at C.R.E.1. The results agree closely with similar figures calculated by Van Krevelen who measured the volatile matter emission, and show that the activation energy involved is approximately

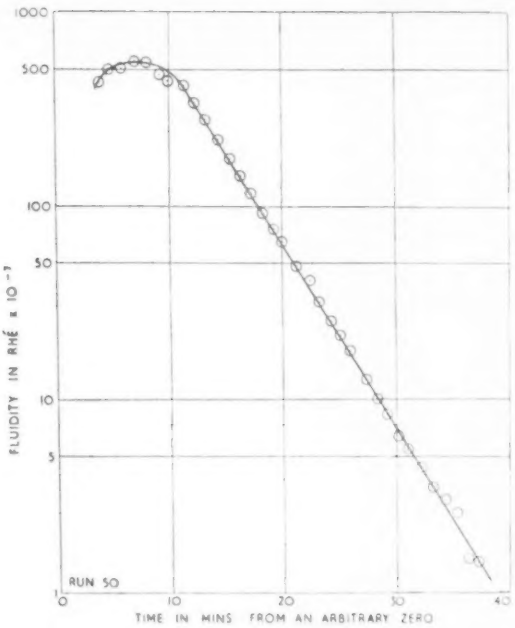


FIGURE 5. *A typical constant temperature Gieseler graph of Manvers coal at 414 ± ½°C. Slope is −0·094 min⁻¹.*

50 K. cal. per mol. (Table V). This is about the same value as that quoted for breaking the C-C bond in the cracking of mineral oil. In the case of coal the reaction possibly involves the separation of a complex attached to the periphery of the graphite-like layer structure.

TABLE V

Coal	*Coal Rank Code No.*	*Dry Ash-free Volatile Matter (per cent)*	*Agglutinating Value B.S.I.*	*Temperature Range over which E is determined (°C.)*	*E (K. cal. per mol.)*	*Reaction Velocity at 420°C. (1/min.)*
Maritime ..	301	24·7	27	419 to 448	52·7	0·033
Manvers ..	502	37·2	27	394 to 416	48·2	0·124
Blackwell (blend)	602/401	37·7	20	402 to 422	54·2	0·161
Grassmoor ..	702	40·0	17	405 to 426	47·3	0·175
New Stubbin	401*b*	35·1	29	397 to 417	47·5	0·135
Parkgate 6 ..	502	38·5	29	408 to 441	47·6	0·114
Thurcroft ..	401	36·1	24	411 to 442	52·2	0·097
Union ..	401	31·5	29	419 to 435	46·7	0·048
Winning ..	602	39·6	24	414 to 429	55·0	0·174
Winning Durham (blend)	602/401	37·4	28	410 to 429	54·6	0·119

Work at Stoke Orchard has shown also how low and high rank coals when suitably blended yield cokes of increased reactivity. Similar effects are obtained when an oxidized second-grade coking coal is blended with the unoxidized coal. The improved combustion characteristics are linked with the more open, unfused nature of the blends containing low rank coals and other factors. Following this work at Stoke Orchard full-scale trials, using blends of high and low rank coals and using high and medium flue temperatures, are now in progress in the divisions of the Board.

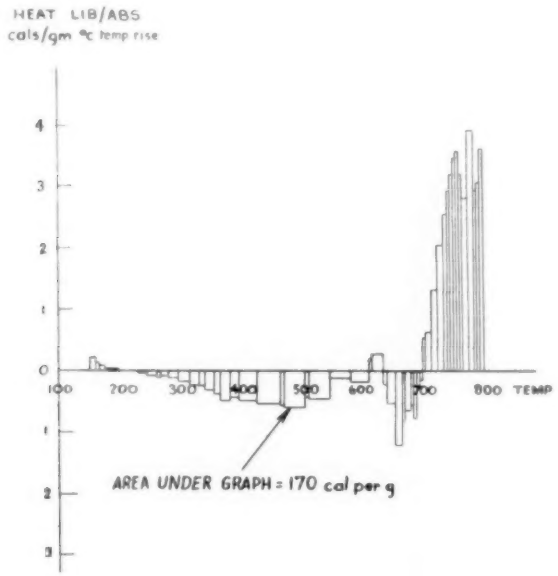


FIGURE 6. *Heat of reaction during carbonization in cal. per g. per °C. plotted as a function of temperature in °C. for Dinnington coal*

In all oven coke production the products must be of a uniform size and this has led us to a study of crack formation in coke with a view to controlling this factor. Cracks are formed in coke during and after the period when the material in the oven is changing from a plastic mass to a brittle solid. The temperature gradients result in the presence of shrinkage gradients extending throughout the mass. An electrical heat flow analogue has been constructed to facilitate the determination of the temperature gradients and heat changes taking place in the ovens. Further light has been thrown by this work on the endothermic and subsequent exothermic changes occurring during the coking of coal (Figure 6).

New processes of coal treatment

Many of the coals from which smokeless fuels and metallurgical coke will have to be made cannot be converted direct into these products, but our research

has shown that they can be pretreated and briquetted and the briquettes then carbonized. The phurnacite process developed in South Wales is a process of this type but the coal used does not require pre-treatment as it is of the non-caking high rank type. Work is in progress to extend the range of suitable coals of which the nearest are the South Wales, Scotland and Kent coals (volatiles up to about 18 per cent). When these are briquetted with pitch and the briquettes carbonized they swell, stick together in clusters or even flow into a solid mass. This is due to the excessive agglutinating value of the coal. Research has shown that the agglutination or fluidity can be reduced or destroyed by a relatively mild pre-oxidation of the coal (Figure 7). We first developed a process involving the use

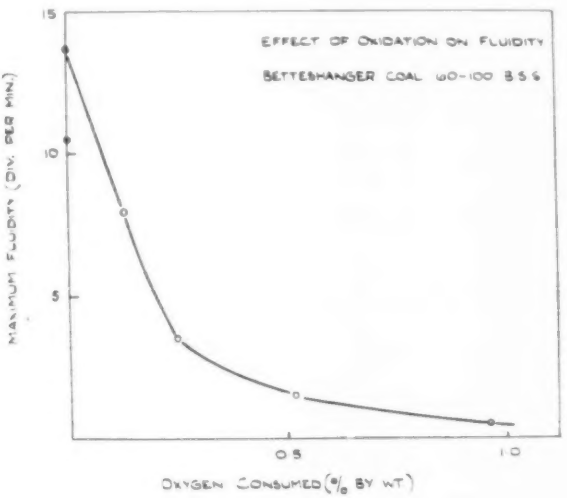


FIGURE 7. *Effect of oxidation on fluidity*

of a rotary retort, but subsequently a new process, involving the oxidation of coal by the fluid bed technique developed for catalytic oil cracking, has been brought to a pilot plant stage at Stoke Orchard, treating 1 ton/hour of coal. It is hoped that this process will be in a state which will permit consideration in the near future of possible translation on to the large scale.

The coals which react well to oxidation and subsequent briquetting and carbonizing are limited in number and the product is a closed appliance fuel. But there is a great need for reactive open grate fuels also and the main source are the low rank, non-caking or feebly caking coals. Processes exist which can convert such coals into smokeless fuels, but they demand either that the coal be in lump form or involve the use of complicated machinery operating at relatively high temperatures. Moreover they are either discontinuous or require the use of numerous small repetitive units. Modern chemical engineering methods tend towards the single units with high throughputs per unit of reactor volume, and research has therefore been directed in the first place to fluidized carbonization.

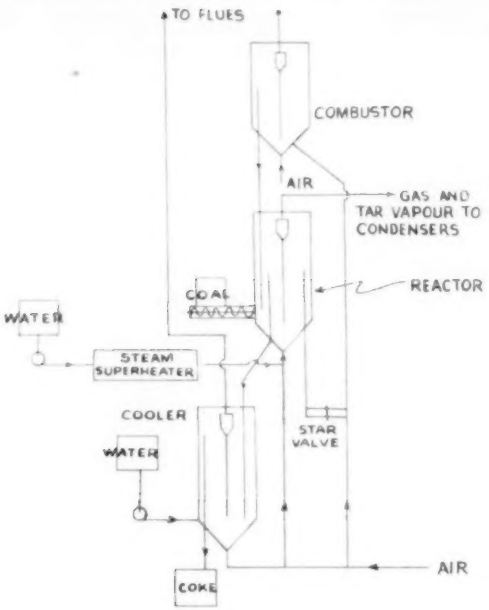


FIGURE 8. *Diagram of oxidation plant*

Various methods of supplying the heat rapidly to the fluid bed have been tried and one involving partial combustion of some of the product char in another fluidized bed would appear to make best use of the favourable properties of fluidized beds, that is rapid mixing and heat transfer and absence of temperature gradients (Figure 8).

Due to the small size of the coal particles being heated and the uniform temperature of the bed, the by-products are evolved rapidly and suffer very little cracking and polymerization. Very high yields are therefore obtained and on the basis of current results at Stoke Orchard Table VI sets out the yields, etc. which might be expected at a hypothetical plant treating 3 million tons of coal per annum.

TABLE VI. BY-PRODUCT YIELDS

on basis of 3,000,000 *tons per year coal carbonized*

Total tar	82,000,000 gallons
Liquor	33,000,000 ,,
Tar composition	
Light oil	8,000,000 ,,
Intermediate oil	8,600,000 ,,
Pitch creosote fuel oil	60,000,000 ,,
Low boiling tar acids	5,400,000 ,,
Gas	12,000,000,000 S.C.F.

While much of our effort is directed towards the technical aspects of this process, the more fundamental aspects are not being overlooked. Investigations have shown that, while minor variations occur between different low rank coals when heated in the range 400–650°C., their rates of decomposition show a remarkable similarity, suggesting that the basic carbonization reactions are the same. The loss in weight is virtually complete after 30 minutes at 400°C., while at 650°C. five minutes is sufficient (Figure 9). Two main reactions appear to be involved, one being ten times faster than the other, and contributing about 70 to 80 per cent to the total loss in weight. The faster reaction would appear to be concerned with tar formation and the slower reaction with gas formation:

this offers interesting possibilities of controlling the gas yield without appreciably decreasing the tar yield.

The product from the fluidized carbonization reactor is a powdered char or semi-coke, and as such it would be quite useless as a domestic fuel. It has therefore to be briquetted or agglomerated. It has no agglutinating value and being highly porous it would require up to twenty per cent of pitch, which is quite uneconomic. The char leaves the carbonizer at a temperature exceeding 500°C., and to cool it down for briquetting and heat the briquettes up again for carbonizing would be wasteful of heat. Attention has therefore been paid to briquetting at elevated temperatures, using a mixture of pitch and fusible coal as binder. The pitch in this case acts as a flux and extends the range of temperature over which the binder will remain fluid and therefore in a condition to wet the char surface and penetrate the pores. This process has been tried successfully on the small scale at Stoke Orchard.

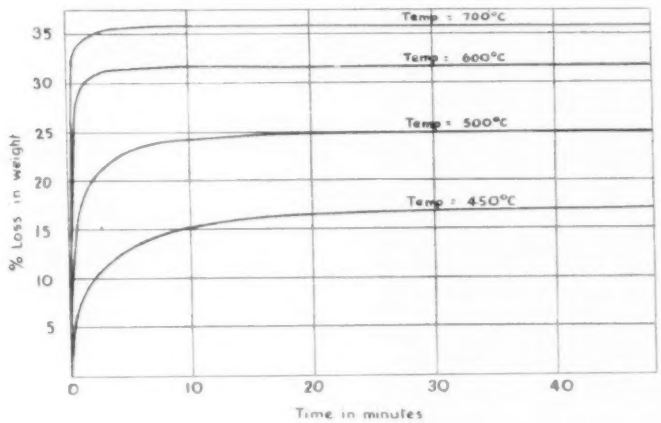


FIGURE 9. *Carbonization of low rank coals: loss in weight/time*

The two stages of the process so far described, fluidization and briquetting, are capable of expansion to high and continuous throughputs. We are therefore endeavouring to evolve a second carbonizing stage for carbonizing the briquettes in keeping with these and have found that it is possible to reduce the residence time to about 30–45 minutes which compares with $4\frac{1}{2}$ hours in the conventional indirectly heated phurnacite retorts. One way of achieving this is to use hot sand in a fluid or mobile bed as the heating medium. This sand process is now being extended to a larger scale at Stoke Orchard (Figure 10).

The three stage process (Fluid Carbonization —> Hot Briquetting —> Fluid Carbonization) which I have described still has a long way to go before we can be certain of its reliability and economics. We are therefore working on alternative processes using conventional plant. A study of the volatile emission curves of coal and some binders shows that the peak for a bitumen bound briquette is at the same temperature as that for the coal, though it extends over a wider range (Figure 11). In the case of pitch the peaks do not coincide, but if certain chemicals

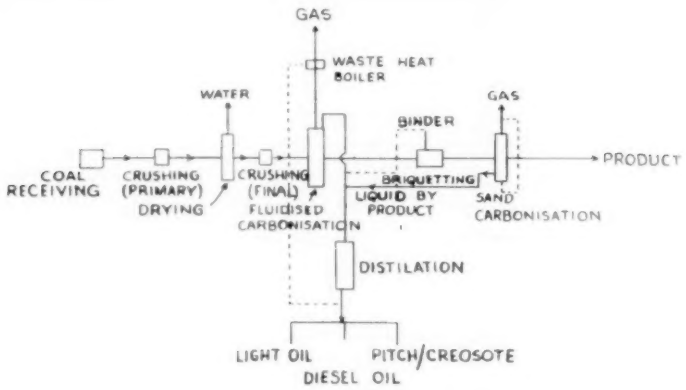


FIGURE 10. *General flow diagram*

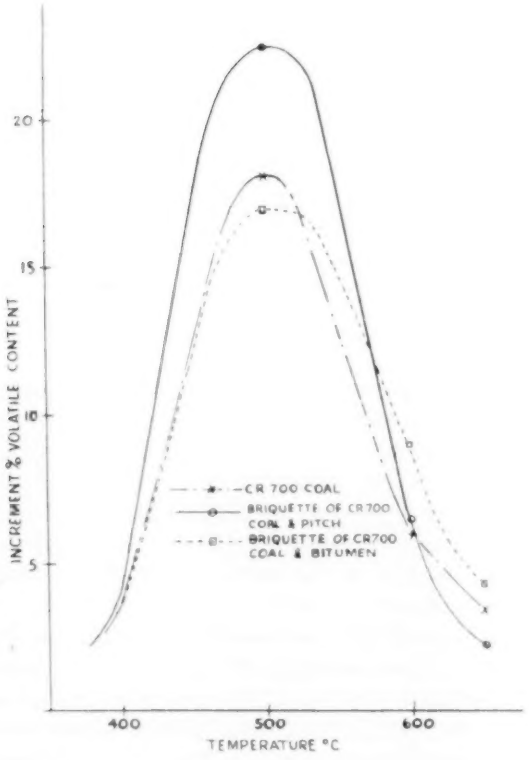


FIGURE 11. *Volatile emission characteristics of a C R 700 coal with pitch and bitumen*

are mixed with the pitch beforehand the volatile emission curve is reduced and widened in a manner similar to that of bitumen (Figure 12). A soft pitch made by stripping the low boiling material from the tar produced by carbonizing the coal again has the effect of lowering the peak of volatile emission and broadening the temperature range over which volatiles are given off (Figure 13).

Work has shown that briquettes made with the aid of these modified binders can be carbonized without distortion or fusion. This opens the way to immediate development to yield a closed appliance fuel.

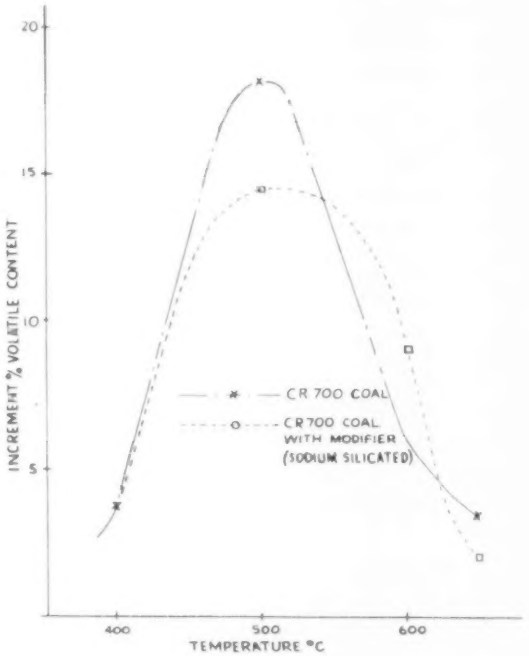


FIGURE 12. *Volatile emission characteristics of a CR 700 coal with a modifier*

It would obviously be a great advantage if the briquetting stage in these various processes could be carried out without using a binder at all, and recent work at Stoke Orchard based on a concept of Rhys Jones and R. Gregory has shown that this can be done without resorting to the enormous pressures used hitherto in Germany and elsewhere for brown coal. The resulting briquettes are very strong, and those made from the low rank feebly caking coals on carbonization yield products of even greater strength. The possibilities of this process in conjunction with the other techniques I have described are considerable; conjointly they would appear to be capable in due course of solving the problems of limited availability of large coal and of coking coal for the production of metallurgical coke and smokeless fuels.

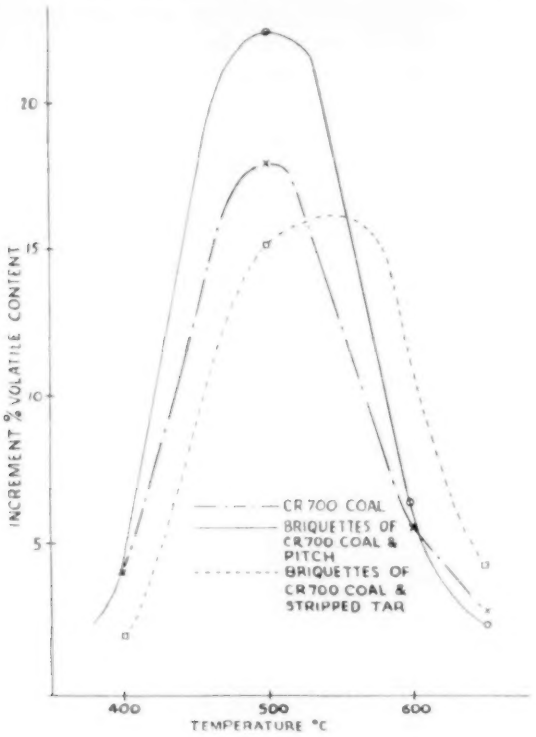


FIGURE 13. *Volatile emission characteristics of a CR 700 coal with pitch and stripped tar*

Considerable effort is being put into all this work at Stoke Orchard and the results have shown that it is possible to a marked degree to control the yields and types of solid, liquid and gaseous products resulting from coal pyrolysis and to produce 'tailor made' smokeless fuel for open or closed domestic appliances and metallurgical cokes, from low rank coals.

A possible application of fluidized carbonization also is in the pretreatment of coals for pulverized fuel boilers, the char being fed to the boilers and the tar, gas and liquor treated separately.

CONCLUSION

The winning of coal is continually becoming more difficult and costly as the shallower seams are being worked out and manpower is becoming more expensive, and increasing regard is rightly being given to the miners' safety and working conditions. The requirements for coal utilization are also becoming more stringent; greater efficiency of use and minimum pollution of the air have to be attained despite the inevitable reduction in availability of the most suitable natural coals.

Research and development on a large scale alone can reconcile these inevitable

trends and, while virtually a beginning only has been made, our achievements justify a quiet confidence in the eventual attainment of our goals.

The author would like to express his thanks to his colleagues for their help in the preparation of his lecture and to the National Coal Board for permission to publish it. The views expressed therein are his own.

BRIGADIER J. L. P. MACNAIR: When describing the process for carbonizing briquettes, the lecturer said that a difficulty was to avoid the necessity for dual heating of the material; and that this method had been devised to overcome that. But surely you are actually still applying a dual heating process, from briquette to carbonizer; they have got to be re-heated in the latter stage, and whether they are heated by red-hot sand or by some other process, surely you are expending the same amount of energy and heat.

THE LECTURER: Normally in the classic method of doing this job you take the cold coal first of all and that goes along to a dryer and is raised to possibly 120° C. After the drying operation it is cooled again, down to, say, 50 to 60° C., then it goes along to a briquetting plant where it is raised in temperature to about 100° C. in a heater where the pitch is mixed with the coal and then it is cooled again to the briquetting temperature which is about 80° C. Then the cold ovoids, the raw ovoids, are taken in belt conveyer along to the carbonizing plant and given the final heat treatment up to about 700° C. and then the temperature of the briquettes drops to atmospheric with the quenching of the hot briquettes.

In the case of the process I referred to in my lecture, we would start first of all with the cold coal which would be increased in temperature in the fluidizing phase. There would be a relatively small drop in temperature of the char in its feeding to the next stage for admixture with the binder and hot briquetting, and the hot briquettes would then be fed direct into the sand carbonizer. Further, there is no reason at all why the sensible heat of the briquettes coming out of the sand carbonizer should not be utilized in some form of heat exchange to give a final recuperation of the residual heat.

THE CHAIRMAN: I said when I first opened this meeting that I had visualized two functions for the Chairman. I am glad to say that the second one has not created any difficulty. There was, however, a third one, which I thought I had better not mention at that time, because it is to return a vote of thanks on your behalf to our lecturer, and, of course it would have been unfortunate if you had received his lecture in such a way that I did not feel justified in offering him a vote of thanks on your behalf. Happy however we are, that that is not the case and I feel quite sure that, from the way in which you have received what Dr. Idris Jones has been telling us, you have been as interested in it all as I have. I do, indeed, on your behalf congratulate Dr. Idris Jones upon the immense scope that he has compressed into such a comparatively short time and I think we are exceedingly grateful to him.

The vote of thanks was carried with acclamation.

SIR JOHN SIMONSEN, F.R.S.: I was taught early in my career that if you wanted to carry out your job efficiently you had to learn about all new developments. I think the Chairman must have been brought up in the same school and have therefore come here to-day to learn these latest developments. As we have already been told, coal is the foundation of our economy, and at the present time also, I should say, of our comfort. We are very grateful to the Chairman for sparing time from his very busy post at the Ministry of Fuel to come here to-day to preside so gracefully over our meeting, and I am sure that the audience will share my gratitude to him.

The vote of thanks was carried with acclamation and the meeting then ended.

THE SECOND EVENING DISCUSSION MEETING

The second of the three experimental discussion meetings arranged in the present session was held in the Library of the Society's House on Thursday evening, 17th February.

The subject for discussion, '*Equality of Education, with special reference to comprehensive schools*', was introduced by Miss Margaret Miles, B.A., Headmistress of Putney County Grammar School. Miss Miles began by saying that when discussing comprehensive schools she thought it would be advisable to omit the political aspect, with which the question was bedevilled. She then traced briefly the developments in education in this country from 1870, when primary schools were first set up, to 1938, the year of the Spens Report. That Committee recommended the development of technical high schools for pupils who were not suited to a more classical education. During the following war years education was the subject of much fertile thought, and, in 1944, a White Paper was published which led to the Act which had established secondary education for all. That was where comprehensive schools came in: it became the duty of local authorities to provide secondary education for boys and girls according to their age, aptitude and ability, and it was to be free; and it seemed to many authorities that the best way of providing it was in one school, a *comprehensive* school.

Miss Miles then reviewed the suggested advantages and disadvantages of this new type of school. Among the advantages were the ease with which late developing children could be transferred from one type of education to another, instead of finding their schooling fixed by an examination at the age of eleven; the increased prestige given to Modern and Technical schooling which could eliminate the feeling that the child was a failure if he could not go to the grammar school; the possibility of providing better and more varied buildings and equipment, and the smaller classes providing the opportunity of giving to all children the responsibility and the education in service, taste and culture which had hitherto been the advantages of the grammar school alone.

The suggested disadvantages were above all its great size and the consequent difficulties of administration and the loss of individuality and of contact between the headmaster or headmistress, staff and pupils in a school of 2,000 children. It was suggested that these might be overcome by good planning of buildings and classes, and an hierarchical structure of administration and responsibility.

During the discussion which followed it was emphasized that its size was the greatest objection to the comprehensive school and this might result in the individual child becoming merely a number among 2,000 others; it was also suggested that the stress on equality would operate to the disadvantage of those who were superior and who deserved and could benefit from special opportunities. It was there pointed out that it was in many ways easier to give special opportunities to the top ten per cent in a large school where they could be released from the duties usually given to the sixth form in a grammar school. Mention

was also made of the merit of comprehensive schools in avoiding the difficulty of selection at eleven plus and the emotional strain which this caused, but it was pointed out that if all Secondary Modern schools were good ones, which at present was disputable, the prejudice against them should disappear and with it the distress of selection.

Those who took part in the discussion included Mr. W. J. Abel, Mr. C. Buchanan, Mr. G. Vivian Davies, Mr. F. S. Height, Mr. Henry Morris, Mr. E. R. G. Newbury, Miss J. L. Scott, and Mrs. Mary Stocks.

The meeting was presided over by Sir Edward Crowe, K.C.M.G., a Vice-President of the Society who, in concluding the discussion, thanked those who had attended for their part in providing an entertaining and instructive meeting.

GENERAL NOTES

ELECTRICAL ENGINEERS' EXHIBITION

An Electrical Engineers' Exhibition, organized for the Association of Supervising Electrical Engineers, is to be held at Earls Court, London, S.W.5, from Tuesday, 15th to Saturday, 19th March, 1955 inclusive, from 10 a.m. to 7 p.m. (Wednesday, until 9 p.m.). A number of tickets for the Exhibition, which will contain exhibits by the British Electricity Authority, various Electrical Associations, and over 200 manufacturers of electrical equipment, have been offered to Fellows by the organizers and may be obtained on application to the Secretary of the Royal Society of Arts.

NOTES ON BOOKS

THE DRAWINGS OF GIOVANNI BATTISTA PIRANESI. *By Hylton Thomas. Faber*, 1954. 42*s*

At the beginning of his book Mr. Hylton Thomas has placed a list of events in Piranesi's life, and in this we read that in 1757 the Society of Antiquaries (not Royal Society of Antiquaries, as he writes) made Piranesi an honorary member. In looking up the original entry in the Society's minute books, one finds under 24th February, this: 'Testimonials were severally presented recommending . . . Il Signor Giovanni Battista Piranesi, a Venetian, resident . . . at Rome as a most ingenious Architect, and author of the Antiquities in Rome and its Neighbourhood in v Vols. Folio . . . desirous of being admitted an honorary Member of this Society'. The *Antichità di Roma* had indeed appeared the year before, in 1756.

If you then turn to the illustrations of Mr. Thomas's book you will see consistently the hand of a brilliant draughtsman, but a spirit far from antiquarian. These architectural drawings, developed in their composition from the precedent of Italian stage design of the Baroque, are highly fantastic, highly Rococo, highly romantic too, whether their theme is Roman, or Greek, or Baroque. Piranesi the archæologist does not appear in the drawings at all. Here surely lies the fascinating problem of his personality and his art. How can the *Prisons* (famous in England by various English editions—the last undertaken by Aldous Huxley) be reconciled to the *Antichità*? Mr. Thomas in his introduction does not touch this problem. The introduction tends to be wordy. It helps one rather to recognise the evolution of Piranesi as a draughtsman than to understand his style. The notes to the plates on the other hand are full and excellent, and the plates are a revelation.

A review is not the place to attempt the solution of major stylistic problems, but it must at least be recorded that Piranesi was one of the most influential artists

and architects in eighteenth century Rome, although he built very little. His influence is consistently on the Rococo and then on the romantic side, not on that of a classical revival, strictly speaking. Travellers brought home his large etchings and hung them up on the walls of their houses. In doing so they thought they kept a record of Roman or Greek buildings, of the Pantheon, the *Tempio di Bacco* or of Paestum, but in fact they commemorated a romantic transformation of Antiquity which thanks to prior admiration for the work of Piranesi had taken place in them, before they ever saw or understood the buildings themselves. It was a complex process, but the outcome of it is certain. Flaxman told Farington that he found the buildings of Rome 'less striking than he had been accustomed to suppose them after having seen the prints of Piranesi'. Piranesi's etchings inspired Robert Adam to draw ruins which otherwise he would probably not have done. The lure of the gigantic scale, which Piranesi could never resist, he passed on to Sir John Soane whose youthful architectural fantasies reflect no example more clearly than that of Piranesi, and to Boullée and Ledoux and other French architects of their generation who never found the way back to reality.

For Piranesi was not an architect. *Invenzioni capricciose* is what he called his most original volume of designs, the *Carceri* or Prisons. Here, and in the drawings even more than the etchings, is the creation of a mood by means of architecture. These are not buildings that would serve their purpose if carried out, or indeed that could be carried out. Vast vaults, huge iron chains hanging down from them, puny helpless human figures, and monumental ceremonial staircases leading up diagonally through unfathomable spaces. The view is always at an angle, the staircases break at right angles, halls open above as well as behind halls. Amongst Piranesi's progeny there are also John Martin and Gustave Doré. That again marks his fascinating position between two styles. The *capriccio*, the contrast of over-large and excessively small, the composition in diagonals through space, all that is characteristic of the Rococo throughout, but John Martin and Doré are romantics of the most sensational brand. This ambivalence of style and subject matter is ever present in Piranesi. It made him fall for the cyclopean grandeur of Paestum, in spite of the fact that he was a defender of Roman architecture against the new Grecian fashion that was coming up. It made him play with Egyptian motifs too, and popularize them by the décor he designed for a celebrated café in Rome.

His influence appears in the most unexpected ways and places, but an influence for a better understanding of those antiquities themselves which he untiringly drew and etched, it could not be. That is one of the lessons of Mr. Thomas's book.

NIKOLAUS PEVSNER

SHORT NOTES ON OTHER BOOKS

THE WORLD OF THE ELSEVIERS, 1580–1712. *By David W. Davies. The Hague, Martinus Nijhoff; London, Batsford*, 1954. 15*s*

This is a history of the famous family of printers and of their relations with the world around them. The nature of the books they published and the controversies in which they were involved, together with the internal state of the printing business, are described, and the state of their reputation to-day is discussed in a final chapter.

FURNITURE FOR MODERN INTERIORS. *By Mario Dal Fabbro. New York, Reinhold Publishing Corporation; London, Chapman & Hall*, 1954. 60*s*

This is a collection of photographs and detailed drawings of modern furniture. After a selection of arrangements for halls and living, dining and sleeping rooms, various pieces of furniture are dealt with in turn. Designers of many countries are represented.

A HANDWRITING MANUAL. *By Alfred Fairbank. Faber*, 1954. 12*s* 6*d*

This is a new revised edition of a book that was first published in 1932. It is a practical guide to the acquisition of good italic handwriting. Exercises are suggested and posture, pens, paper and ink are discussed. There are many examples of good writing and diagrams in the text.

FORM IN ENGINEERING DESIGN. *By J. Beresford-Evans. Oxford, Clarendon Press*, 1954. 10*s* 6*d*

This is a guide to industrial design from the engineer's viewpoint. There are chapters on the Designer's Responsibility, Form in Engineering Design, Proportion, Detail, Meters and Handles, and Finishes and Presentation. The book is well illustrated.

DEGAS: SECOND VOLUME. *With an introduction and notes by Michael Ayrton. Faber*, 1953. 9*s* 6*d*

This is one of the series, 'The Faber Gallery'. Ten paintings by Degas are reproduced in colour with notes and a short introduction to preface them.

PORCELAIN THROUGH THE AGES. *By George Savage. Penguin Books*, 1954. 5*s*

This is a survey of the products of the main porcelain factories of Asia and Europe. All the famous makers are dealt with *seriatim*, and there is an historical survey of the art in each country. In addition, there are 64 pages of plates, many line drawings, a bibliography, and tables of maker's marks.

IRAN. *By R. Ghirshman. Penguin Books*, 1954. 5*s*

This is a history of Persia from the earliest times until the Islamic conquest. The art and architecture and social history of the people form a large part of the contents of this not so slim volume. There are 48 pages of plates and many line drawings in the text.

FROM THE JOURNAL OF 1855

VOLUME III. *2nd March*, 1855

From a paper On the Iron Industry of the United States, by Professor John Wilson, F.R.S.E.

The iron industry of the United States is at present only in its infancy, an offspring quite of the present century. Its growth has been somewhat irregular, it is true, but when we find that it has already reached the gross amount made in this country only 20 years ago, and when we recollect the vast mineral resources of the United States, the rapid increase of population, with its increasing demands, and its unquestionable energies and power of application, it forces upon our minds the conviction that the time is not far distant when it will not only furnish sufficient for its own consumption, but be in a position to compete with us in the other importing markets of the world. In the different districts I visited, I found every advantage taken of our experience in the construction and working of their establishments. Everywhere the charcoal forge was giving way to the superior advantages of the hot-blast anthracite furnace. *Economy of production* was the main object of the manufacture, the quality of their ores and fuel always guaranteeing a good article. The use of the waste gases of the furnace was universal in their establishments; the difference of opinion as to their value, so startling in this country, did not appear to exist there.

Some Activities of Other Societies and Organizations

MEETINGS

MON. 7 MAR. Electrical Engineers, Institution of, Savoy Place, W.C.2. 5.30 p.m. *What is the Future of the Steam Locomotive* (Discussion).
Engineers, Society of, at the Geological Society, Burlington House, W.1. 5 p.m. W. E. Ripper: *Spraying of Crops by Helicopter.*
Geographical Society, Royal, South Kensington, S.W.7. 8.30 p.m. Merlin Minshall: *Sailing Across Europe.*

TUES. 8 MAR. Civil Engineers, Institution of, Great George Street, S.W.1. 5.30 p.m. D. R. R. Dick: *The Civil Engineer and Britain's Atomic Factories.*
International Affairs, Royal Institute of, 10 St. James's Square, S.W.1. 1.30 p.m. Sir Henry Bradshaw: *Some Aspects of the Argentine To-day.*
Manchester Geographical Society, 16 St. Mary's Parsonage, Manchester, 3. 6.30 p.m. W. A. Singleton: *Deserted Medieval Villages.*
Mechanical Engineers, Institution of, 1 Birdcage Walk, S.W.1. 5.30 p.m. A. T. Wilford: *Analysis and Interpretation of Service Records.*

WED. 9 MAR. Archaeological Institute of Great Britain and Ireland, Royal, at the Society of Antiquaries of London, Burlington House, Piccadilly, W.1. 5 p.m. Glyn E. Daniel: *The Allées Couvertes of France.*
Central Asian Society, Royal, at the Royal Society, Burlington House, Piccadilly, W.1. 1.30 p.m. Philip Mason: *Afro-Asian Conference Prospects.*
Electrical Engineers, Institution of, Savoy Place, W.C.2. 5.30 p.m. P. E. Axon, C. L. S. Gilford and D. E. L. Shorter: *Artificial Reverberation.*
International Affairs, Royal Institute of, 10 St. James's Square, S.W.1. 8 p.m. Philip Mason: *Racialism in South Africa.*
Italian Institute, 39 Belgrave Square, S.W.1. 6.30 p.m. Professor Roberto Weiss: *Italian Cities of the Middle Ages and the Renaissance: Verona.*
Newcomen Society, at the Science Museum, South Kensington, S.W.7. 5.30 p.m. (1) W. K. V. Gale: *Hand Wrought Chains* (2) G. M. Watkins: *The Vertical Winding Engines of Durham.*
Petroleum, Institute of, 26 Portland Place, W.1. 5.30 p.m. L. Grunberg: *The Viscosity of Liquid Hydrocarbons.*
Sanitary Institute, Royal, 90 Buckingham Palace Road, S.W.1. 2.30 p.m. W. G. Patterson and S. L. Wright: *Co-operation between Local Health Authorities and the Hospital Service—Possibilities and Actualities.*
Victoria & Albert Museum, South Kensington, S.W.7. 6.15 p.m. Margretta Stroup Austin: *Past and Present Trends in American Painting.*

THURS. 10 MAR. Electrical Engineers, Institution of, Savoy Place, W.C.2. 5.30 p.m. F. W. Roberts: *The Electrical Equipment of the Toronto Subway Cars.*
Fuel, Institute of, at the Institution of Civil Engineers, Great George Street, S.W.1. 5.30 p.m. Dr. W. Gumz: *Fuel Developments in Germany.*
Physical Society, at the Science Museum, Exhibition Road, S.W.7. 4.30 p.m. Dr. G. Haselden: *Some Experimental Problems Encountered in a Study of the Fractionation of Liquid Air.*
Textile Institute, at 10 Blackfriars Street, Manchester, 3. 7 p.m. W. A. Richardson: *Some Properties of Fibre Blends.*

FRI. 11 MAR. Engineers, Junior Institution of, Pepys House, 14 Rochester Row, S.W.1. W. H. Bailey: *The Rolling of Structural Sections.*
Engineers and Shipbuilders, North East Coast Institution of, at the Mining Institute, Neville Hall, Newcastle-upon-Tyne. 6.15 p.m. D. F. Collins: *A Comparison of the Total Weight and Bulk of in-Line Naval Gas Turbine Engines of Differing Degrees of Complexity.*
Mechanical Engineers, Institution of, 1 Birdcage Walk, S.W.1. 5.30 p.m. Robert Cass: *Heavy Duty Truck Developments.*

SAT. 12 MAR. Horniman Museum, London Road, Forest Hill, S.E.23. 3.30 p.m. Hugh Shortt: *The Development of Monumental Sculpture in the West.*

MON. 14 MAR. Geographical Society, Royal, South Kensington, S.W.7. 5.30 p.m. *Life of the Adélie Penguin* (Film).
Transport, Institute of, 66 Portland Place, W.1. 5.45 p.m. James Maxwell: *World Tourism.*

TUES. 15 MAR. Chadwick Trust, at the Royal Society of Tropical Medicine and Hygiene, 26 Portland Place, W.1. 5.30 p.m. E. J. King: *Silicosis.*
Electrical Engineers, Institution of, Savoy Place, W.C.2. 5.30 p.m. J. C. West and J. L. Douce: *The Mechanism of Sub-harmonic Generation in a Feedback System.*
Industrial Transport Association, at the Royal Society of Arts, W.C.2. 6.30 p.m. H. Snelling: *The Development of Independent Air Transport.*
International Affairs, Royal Institute of, 10 St. James's Square, S.W.1. 1.30 p.m. Lt.-Col. G. E. Wheeler: *Soviet Policy in Central Asia.*
Manchester Geographical Society, 16 St. Mary's Parsonage, Manchester, 3. 6.30 p.m. George Dixon: *Approach to the Jungfrau.*

WED. 16 MAR. British Kinematograph Society, at G.B. Theatre, Film House, Wardour Street, W.1. 7.30 p.m. G. H. Cook: *Modern Cine Camera Lenses.*
Electrical Engineers, Institution of, Savoy Place, W.C.2. 5.30 p.m. R. T. Rushall and J. S. Simons: *An Examination of High Voltage D.C. Testing Applied to Large Stator Windings.*
Microscopical Society, Royal, Tavistock House South, Tavistock Square, W.C.1. 5.30 p.m. E. H. Leach: *Retinal Structure and Colour Vision.*
Victoria & Albert Museum, South Kensington, S.W.7. 6.15 p.m. G. R. Hughes: *Treasures of the City Companies.*

THURS. 17 MAR. Chemical Society, Burlington House, Piccadilly, W.1. 7.30 p.m. Prof. E. L. Hirst: *Some Problems in the Chemistry of the Hemicelluloses.*
Electrical Engineers, Institution of, Savoy Place, W.C.2. 5.30 p.m. A. O. Johnson and N. F. Marsh: *The Standardization of Retail Electricity Tariffs.*
Road Transport Engineers, Institute of, at the Royal Society of Arts, W.C.2. 6.30 p.m. *Some Aspects of Vehicle Insurance and Accident Assessment.*

FRI. 18 MAR. Engineers, Junior Institution of, Pepys House, 14 Rochester Row, S.W.1. R. F. Twist: *Some Notes on the Flow of Fluids.*

OTHER ACTIVITIES

MON. 7 MAR. UNTIL SUN. 13 MAR. Imperial Institute, South Kensington, S.W.7. 12.30 p.m., 1.15 p.m. and 3 p.m. Weekdays, 3 p.m. and 4 p.m. Saturdays, 3 p.m., 4 p.m. and 5 p.m. Sundays. Films: *Pondo Story—South Africa; Tasmania To-day—Australia.*

WED. 9 MAR. Building Centre, 26 Store Street, W.C.1. 12.45 p.m. Film Show: *The Battrey Press: Preference Battrey.*

MON. 14 MAR. UNTIL SUN. 20 MAR. Imperial Institute, South Kensington, S.W.7. 12.30 p.m., 1.15 p.m. and 3 p.m. Weekdays, 3 p.m. and 4 p.m. Saturdays, 3 p.m., 4 p.m. and 5 p.m. Sundays. Films: *Leadership in Togoland—Gold Coast; Land of Zinj—East Africa.*

TUES. 15 MAR. UNTIL THURS. 17 MAR. Oil and Colour Chemists' Association, at the Royal Horticultural Society's Old Hall, Vincent Square, S.W.1. *Exhibition of Raw Materials and Equipment used in the Paint, Varnish and Printing Ink Industries.*

WED. 16 MAR. Building Centre, 26 Store Street, W.C.1. 12.45 p.m. Film Show: *The Yorkshire Point of View.*

NOW UNTIL 12 MAR. Sanitary Institute, Royal, in the Museum of Hygiene, 90 Buckingham Palace Road, S.W.1. Exhibition: *You versus Pests—Insects that Attack Food and Endanger Health.*

NOW UNTIL 12 MAR. L.C.C. Central School of Arts and Crafts, Southampton Row, W.C.1. Exhibition: *Austrian Theatre Design.*

NOW UNTIL 24 MAR. Bund Deutscher Architekten, at the Royal Institute of British Architects, 66 Portland Place, W.1. Exhibition: *German Architecture To-day.*